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BLIND CHILDREN'S UNDERSTANDING OF VISION

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Submitted for the degree of Doctor of Philosophy

Open University

Centre for Childhood, Development and Learning

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DEDICATION

This thesis is dedicated to my parents, Freda Livesey and Ernie Livesey, who brought me up to value knowledge for its own sake, who taught me about the important things in life, and have shown unwavering love and support for me, and without whom none of this would have been possible. Thank you.

DECLARATION

The work contained in this thesis has been carried out entirely by the author. None of the material has been submitted previously for a degree or similar purpose.

ABSTRACT

This thesis explores the effects of congenital blindness upon the development of understanding of vision, and draws on the theoretical frameworks of understanding of aspectuality and visual perspective-taking. Six studies investigated how blind children demonstrated their understanding of vision. Where appropriate, their performance was compared to a control group of sighted children. The views of parents and educators of congenitally blind children were sought in order to gain insight into social influences upon the development of blind children's understanding of vision.

Sixteen congenitally blind children aged from 3;6 to 14;8, 168 typically developing sighted children aged from 3;6 to 14;8 and 58 sighted adults took part in the studies. There were three main findings. First, the associative stage in understanding of the aspectuality of knowledge for blind children may be manifest in the relationship between touching and knowing. Second, when utilising a more naturalistic setting than has commonly been used, blind children aged between three and 11 years were able to hide successfully, raising questions about the position that Level 1 perspective-taking is not present in blind children until the age of at least six or seven years, and possibly not until ten years. Third, blind participants demonstrated an understanding of mind earlier than has been found in other studies, suggesting that the development of theory of mind in congenitally blind children may not be as delayed as was previously thought. Several educational issues were raised, including the manner in which blind children are taught about vision, and their placement in ability-groups in mainstream classrooms.

CHAPTER ONE

BLIND CHILDREN'S UNDERSTANDING OF VISION

1.1. Introduction

The study of blind children's understanding of vision has received little attention in the literature. This is surprising because the ability to predict what another person sees is related to, and instrumental in, many areas of cognitive and social development. Specifically, it is a key component in the development of *perspective-taking* (Flavell, 1978; Flavell, Botkin, Fry, Wright, & Jarvis, 1968), which can be defined as the ability to understand the perceptual, emotional, cognitive or motivational reactions of other persons, even when these differ from one's own perspective (Sibereisen, 1995, cited in Brambring, 2005). Perceptual perspective-taking is the first type to emerge (Brambring, 2005), and since the appearance of the seminal study of Piaget and Inhelder (1956) many developmental researchers have investigated visual perspective-taking (e.g. Bridges & Rowles, 1985; Cox, 1986; Flavell, 1978; Flavell et al., 1968; Masangkay et al., 1974; Moll & Tomasello, 2006; Pratt & Bryant, 1990).

The absence of visual experience makes it difficult for children who are blind from birth, with light perception or less (referred to forthwith as 'congenitally blind') to assimilate what effects, if any, factors such as occlusion, distance and relative position have upon the observer's ability to see objects (e.g. Bigelow, 1991a; Nock, Lewis, Collis, & Burns, 2003a). In the case of sighted children, understanding the visual experience of other people and the ability to take the visual perspective of another increases in accuracy with cognitive and conceptual development (Flavell, Green, Herrera, & Flavell, 1991). The ability to predict what another person can see is more

complex for congenitally blind children than for sighted children because their understanding of vision and the ability to take the visual perspective of another person is affected not only by general cognitive development, but by the ability to grasp rules and conditions relating to a modality to which they do not have direct access, and can only understand either through explanations about vision, or by analogy to their own perceptual experiences (Bigelow, 1991a; Nock et al., 2003a; Nock, Lewis, Collis, & Burns, 2003b).

Additionally, predicting what others can see is a fundamental element in the development of understanding of the *aspectuality of knowledge*, that is the understanding that different types of sensory experience lead to different types of knowledge (Dretske, 1969; Perner, 1991). For example, knowledge about an object's colour is gained through visual experience whilst knowledge of the texture of the same object is gained through tactual experience.

There are also links between understanding of what another sees and the development of *theory of mind*. It has been suggested that visual perspective-taking ability is a necessary requirement that both precedes and makes possible an understanding of false belief (Gopnik, Slaughter, & Meltzoff, 1994). Perceptual experiences and understanding of how perception is experienced in self and others are critical elements in formulating a theory of mind (Astington, 1993), and in order to understand beliefs about ourselves and others, it is necessary to understand how beliefs are acquired. It has been proposed that one early milestone in the acquisition of theory of mind is the understanding that seeing leads to knowing (Taylor, 1988; Weinberger & Bushnell, 1994), and without that fundamental knowledge, acquisition of theory of mind may be

delayed. Further, some researchers (e.g. Gopnik & Graf, 1988) consider that the ability to reflect upon the origins of our own mental representations is an essential prerequisite for understanding about the aspectuality of knowledge

Understanding of vision has been shown to influence the development of knowledge of 'self' (Bischof-Kohler, 1991; Flavell, Shipstead, & Croft, 1980) including *knowledge about self-exposure and visibility to others* (Flavell, Shipstead, & Croft, 1978). Building up an understanding of their own bodies, and the relationship of each body part to the others is difficult for blind children: they cannot see themselves reflected in a mirror, nor can they see the whole of the body of another person and comprehend how each part of the body relates to the others (Fraiberg & Adelson, 1975). In the absence of vision, the blind child must find other ways to build up a concept of self.

For sighted people, vision is arguably the most constant source of perceptual information, and none of the other modalities is as prominent. During the waking hours there are frequent periods of silence, many moments when no specific tactual experiences are being sought through manual exploration, and long periods where odour or taste stimuli are absent. Moreover, even during times when the other four modalities are active, they are usually simultaneously accompanied by visual information about what is heard, felt, smelt or tasted. It may be because of this predominance of vision as a source of information that many visual terms are used as synonyms for 'know' or 'understand', for example 'Do you see what I mean?' Visual expressions are also used in cultural or figurative terms, such as 'green with envy', or 'red-letter day'. Language, of course, also uses visual terms in their concrete meaning,

for example ‘shadow’, ‘bright’, ‘purple’, ‘look’ etc. In a world where the visual is so important, if blind children have no understanding of such visual terms, and are unable to use them, they may feel excluded from the conversations, activities and indeed the worlds of sighted people. Understanding about the visual experiences of others may contribute to the development of the proficient *use and understanding of the language of vision*, which Carey (2002) terms visual literacy.

The areas identified above viz. perspective-taking, understanding about the aspectuality of knowledge, knowledge about self-exposure and visibility to others, and the use and understanding of the language of vision, are the developmental topics upon which this thesis will concentrate. To a lesser degree, because of its links with both perspective-taking and understanding the aspectuality of knowledge, theory of mind will also be discussed within the context of these areas.

It is important to note though, that these areas are by no means exhaustive, and there is evidence to suggest that congenital blindness underlies problems in other areas such as language development (Fraiberg, 1977), motor development (Hatton, Bailey, Burchinal, & Ferrell, 1997), spatial awareness and understanding (Lewis, Collis, Nock, Twiselton, & Burns, 2004) and symbolic play (Andersen, Dunlea, & Kekelis, 1984).

Understanding about vision then, is important and influential in many areas of development. Thus, knowledge and understanding of the visual experiences of sighted people is likely to be of value to congenitally blind children in order to maximise their

development in a number of cognitive areas, and to facilitate their inclusion through proficient understanding and production of the language of vision.

This introductory section has introduced some of the developmental areas that are thought to be influenced by visual experience, and has identified the topics that will be investigated in this thesis. Also it has been argued that it is important for congenitally blind children to understand about the visual experiences of sighted people.

The primary aim of this thesis is to explore blind children's understanding of vision, thus addressing the gap in the literature. However, studying children with any impairment can present the researcher with a number of challenges, and the next section will provide a brief outline some of these.

1.2. Issues to consider when carrying out research with children with impairments

One of the main difficulties relates to the issue of categorising children around a specific impairment, as if assuming that all children who are, for example, blind (or deaf, or have autism) are somehow the same. Blind children, like their sighted peers, vary in their abilities, intelligences and experiences. Further, they also vary in the extent and nature of the impairment, and the age at which they became blind. Even a very little vision can have a marked effect on development. For example, although blind children are delayed, relative to sighted children, in the development of motor skills, those with light perception only are more delayed than those children with some form perception (e.g. Hatton et al., 1997). Both sighted children and children

with low vision (severe to profound visual impairment with acuities ranging from 20/200 (6/60) up to but not including finger counting at one metre) performed better than congenitally blind children (born blind and having no more than minimal light perception) on tasks that measured understanding of perspective-taking (Miletic, 1995). Evidence from Bigelow (1991c; 1996) indicated that children with low vision are more successful than those who have only light perception when building up spatial representations of familiar space. Thus, the degree of blindness that a child has bears considerable implications in developmental terms. Only congenitally blind children with light perception or less were included in the empirical studies reported in this thesis in order to keep to a minimum the effects of different degrees of blindness and/or early vision on the development of understanding about vision.

Thus, while it is appropriate to assume that the impairment that children have in common may affect their development in similar ways, it is also important to remember that their individual characteristics, experiences and the level of impairment will influence the effect that their shared impairment may have on specific areas of development.

Grouping together and labelling are not the only problems that arise when researching children with impairments. Issues related to under- and over-estimation of ability, data collection and analysis and use of appropriate methodology also present potential challenges when carrying out research with children, particularly children with impairments. These areas will be discussed in Chapter Six, with particular reference to the study of children who are congenital blind, and some strategies overcoming potential difficulties will be suggested.

Studying children with impairments, both physical (e.g. Bigelow, 1988; Kyle & Allsop, 1982; Lewis et al., 2004; Mulderij, 2000) and mental (Baron-Cohen, Leslie, & Frith, 1985; Cicchetti & Stroufe, 1978), is by no means an original or new practice, and it is hoped that the findings of this thesis will fit into and enrich the framework that already exists. In the following section, the case for studying children with impairments will be argued.

1.3. Theoretical and practical reasons for studying children with impairments

Many researchers have highlighted the benefits of studying the development of children with impairments for illuminating and advancing understanding of developmental processes. Examples include the effect of Down Syndrome on the development of affect (e.g. Cicchetti & Stroufe, 1978), the effect of a range of impairments including cognitive impairments, learning difficulties, deafness and autism on the acquisition of language (Adamson & Ronski, 1997; Bishop & Mongford, 1993), and the effect of autism and Down Syndrome on the emergence of intuitive knowledge relating to the three core domains of psychological, physical and biological phenomena (Binnie & Williams, 2002). Research into the development of blind children is the focus of this thesis, and studies in this area of impairment include the effects of blindness on early ego development (Fraiberg, 1968), the acquisition of language (Wode, 1993), play and concept development (Recchia, 1997) and the development of spatial ability (Lewis et al., 2004; Ungar, Blades, & Spencer, 1995a, 1995b, 1996).

The study of children with impairments such as blindness is important for both theoretical and practical reasons. Theoretical understanding of developmental

processes is informed in a number of different ways. For example, findings about how a particular impairment affects developmental processes provide information about whether certain areas of development are linked, or if a particular developmental milestone is a prerequisite for the attainment of another milestone (e.g. Lewis, Norgate, Collis, & Reynolds, 2000, on the link between the development of language and symbolic play). Alternatively, such findings can challenge earlier conclusions by clarifying that there is no link between such developments, but that the two simply emerge at around the same time in typically developing children, where there is no disruption to the developmental pathway (e.g. Peterson, Peterson, & Webb, 2000).

Similarly, it is only through exploring earlier findings about the effects of impairment that erroneous findings can be challenged. For example, it has been suggested that blind children are delayed in their acquisition of language (e.g. Fraiberg, 1977). This phenomenon was explored by Landau and Gleitman (1985). They found that although sighted children produce auxiliary verbs earlier than blind children and produce complex sentences like 'I am eating a burger', while blind children are still using the simpler form 'I eat burger', this delay is related not directly to the children's blindness, but to the differences in the language that mothers use to their blind and sighted children. Mothers of blind children tend to stress words that have concrete meaning even outside of a sentence, to the detriment of subordinate words. Mothers try, maybe unconsciously, to make language easier for their children, when in fact their neglect of function words diminishes the grammatical sophistication of blind children. Thus, in actuality, the delay in the acquisition of complex language structure sometimes observed in blind children is not directly a product of their lack of vision, but at least partially, of the linguistic behaviours of their parents. This example

illustrates the importance of not assuming that an impairment is the cause of any observed difference in the developmental pathway. There may be less obvious causal factors.

In practical terms, accurate and detailed theoretical accounts of the development of both typically and atypically developing children are valuable because they can inform the provision of appropriate, relevant and effective interventions, aimed at improving the developmental progression in both populations.

The overarching purpose of this thesis is to explore how congenital blindness affects the development of understanding of vision, and the aims outlined in the following section provide a framework for that exploration.

1.4. Aims of the thesis

Five main aims provide a scaffold upon which to explore the effects of congenital blindness upon the development of understanding of vision:

1. To explore whether, and if so to what extent, the absence of visual experience influences the development of understanding of the aspectuality of knowledge.
2. To examine whether, and if so to what extent, the absence of visual experience influences the ability to take the visual and auditory perspectives of another person.
3. To investigate and compare the opinions of blind and sighted children about the phenomena that affect vision.
4. To explore blind children's ability to hide themselves, as an indication of their ability to take the visual perspective of another person.

5. To explore some social influences upon the development of understanding of vision and the language of vision.

1.5. Organisation of the thesis

A review of the literature regarding the development of understanding of the aspectuality of knowledge in sighted and blind children is presented in Chapters Two and Three. Chapters Four and Five review the literature on the development of perspective-taking ability in sighted and blind children. Because theory of mind is related to both perspective-taking and understanding the aspectuality of knowledge, this is also discussed as appropriate within the context of Chapters Two to Five. In each of these key areas, the development of sighted children is discussed first, followed by what is currently known about blind children's development in the same area. Salient questions are raised for each of the developmental areas, some of which are explored in the empirical studies reported in later chapters. A discussion of pertinent methodological issues, and information about the participants is presented in Chapter Six. The six empirical studies are reported in Chapters Seven to Twelve and finally, the findings are summarised and discussed in Chapter Thirteen.

CHAPTER TWO

SIGHTED CHILDREN'S UNDERSTANDING OF THE ASPECTUALITY OF KNOWLEDGE

2.1. Introduction

As adults, we understand that there is a relationship between perceptual experience and knowledge. For example, vision provides, among other things, information about the colour of an object, whilst smell provides information about its aroma. Thus, we understand that experience is a necessary prerequisite for knowledge to be attained, and that different types of sensory experience provide different types of knowledge (Dretske, 1981). Some object properties can be determined through more than one sensory modality, for example shape can be determined through vision and touch, while other properties can only be discovered through one modality. Colour, for example, can only be determined through vision. The appreciation that a specific sensory modality leads to a certain type of knowledge is referred to as knowledge of *aspectuality* (Dretske, 1969; Perner, 1991).

2.2. What do sighted children understand of the aspectuality of knowledge?

The literature to date suggests that understanding of aspectuality begins to develop in sighted children at between three and four years of age, though this understanding is inconsistent and haphazard. For example, although three- and four-year-olds are able to *obtain* a particular type of knowledge through a specific modality, they are frequently unable to state *how* they acquired the information, and are also unable to assess the knowledge level of another person after observing the other person either being given, or denied, sensory information about an object (Wimmer, Hogrefe, &

Sodian, 1988). Older four- and particularly five-year olds, however, demonstrate that they do understand the modality-specific nature of knowledge and there is evidence to suggest that children of this age can identify the sources of their own and others' knowledge, at least in the visual and tactual modalities (e.g. Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Sodian, 1988).

By the age of six years, children's understanding of the aspectuality of knowledge, both in relation to themselves and others, is similar to adult performance, again, at least where seeing and touching are the modalities in question (O'Neill, Astington, & Flavell, 1992). How can these differences in ability be explained? What do children need to be able to understand before they are able to succeed on tasks that explore their understanding of aspectuality? The following four sections address these questions.

2.3. A developmental approach to understanding of the aspectuality of knowledge

The evidence to date suggests that there are three stages of development of understanding of the aspectuality of knowledge (e.g. O'Neill et al., 1992). Level 1 is termed the associative stage and occurs around three to four years of age. In this stage, sighted children have some understanding of the association between knowledge and sensory experience, but understanding is limited to the association between visual experience and knowledge (O'Neill & Gopnik, 1991; Perner, 1991). When given simple tasks, and asked simple questions, children of this age are able to demonstrate that they understand that there is a relationship between seeing and knowledge. For example, they understand that if they or another person sees a sweet, they know that

the sweet is present; they understand that visual perception and knowing tend to go together (O'Neill et al., 1992; O'Neill & Gopnik, 1991; Perner, 1991). Thus, they know that if they or another person has seen an object they will know about it and if they have not seen it, they will not know about it (Pillow, 1989; Pratt & Bryant, 1990). This level of understanding does not require that children appreciate what characteristics of the sweet can be discerned from seeing it, or that they are able to understand which other senses will need to be employed to find out for example, the weight (tactual and proprioceptive modalities), the flavour (taste modality) or the odour (olfactory modality).

Also, in the associative stage children are able to use vision as a source of informational access, so when asked to find out the colour of an object, will look at that object to gather the required information. When vision is the source of access, children are also able to state that it was looking at the object that enabled them to know the particular characteristic, but they are unable to do this in relation to the other four sensory modalities. O'Neill et al. (1992) suggest that this is because vision is understood by young children in associative terms, as detailed above. For them, seeing is knowing. So when they state that they know, for example, the colour of the sweet because they looked at it, this is a result of a general heuristic rather than causal understanding of sensory access and knowledge.

The second stage of development is reached at around four to five years of age, when understanding of the causal relationship between sensory experiences and knowledge begins to emerge. This level of understanding relates to Dretske's (1981) characterisation of knowledge: the understanding that experience is a necessary

prerequisite for knowledge to be attained, and that different types of sensory experience provide different types of knowledge. When children understand this concept, they appreciate that there is a reason - a causal factor - for their own, and others' knowledge states (Wimmer, Hogrefe, & Sodian, 1988), and there is some evidence to suggest that some four-year-olds are capable of identifying the sources of their own and others' knowledge when seeing, feeling and telling are the source types in question (Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Sodian, 1988).

The third and final stage of understanding the aspectuality of knowledge is reached when children understand that although seeing can result in, for example, knowledge that a sweet is present, seeing is also the source of the information that the sweet is yellow. They also appreciate the fact that if they want to know whether the yellow sweet is hard or squashy, they need to feel it. Similarly, if they want to know whether it is lemon or banana flavoured, they need to taste it. In short, when children reach this stage of development, they understand that an object's identity is assembled from discrete properties that are obtained individually through a person's multi-sensory experiences with the object (O'Neill & Astington, 1990). They also understand about complex intermodal equivalences, for example, that roughness or shape can be perceived though both vision and touch. By the age of six years, children's ability to ascribe knowledge to themselves and others closely resembles adult performance, at least for the tactual and visual modalities (O'Neill et al., 1992).

A range of methodological approaches has been employed to produce the findings described in this section, and the discussion now turns to a consideration of some of these methods.

2.4. Methods for investigating understanding of the aspectuality of knowledge

When exploring children's emerging understanding of the aspectuality of knowledge some psychologists have simply asked children to give a reason for how they know something (e.g. Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Perner, 1988; Woolley & Bruell, 1996). For example, children have been asked to find out the contents of a box or similar container through one mode of access, such as looking, and then asked to state how they found out the information. In some studies, the questions posed are open-ended (e.g. Wimmer, Hogrefe, & Sodian, 1988), while others present two or more forced-choice questions (e.g. Gopnik & Graf, 1988; O'Neill & Gopnik, 1991). For example, Gopnik and Graf (1988) used a very simple task to explore young children's ability to identify the source of their beliefs. Seeing, telling and feeling were selected as the three source types. The researchers placed a toy helicopter, a toothbrush and a plastic cup in turn inside a small model tunnel. For the 'See' trial, the helicopter was placed in the tunnel and the researcher said 'Lift the tunnel up and look inside. Can you see what's inside?' Similarly, in the 'Tell' trial, the toothbrush was placed inside the tunnel and the child was told that he/she could not look inside this time, but that the researcher was going to tell him/her what was inside. In the 'Feel' trial, the cup was placed in the tunnel and the child was invited to put his/her hands in the tunnel to feel what was inside. After each trial, he/she was asked to identify the object in the tunnel, and the source was explicitly mentioned in each case, for example '*What did you see inside the tunnel?*' The child was then asked

the open-ended question *'How do you know that's what's inside the tunnel?'* If the child was unable to respond, the researcher asked a forced-choice question: *'Did you see it, did I tell you, or did you feel it?'* With both the open-ended and forced-choice questions, the three-year-olds had difficulty identifying the source of their knowledge but four- and five-year-olds did not, consistent with other findings in the literature (e.g. Sodian & Wimmer, 1987; Wimmer, Hogrefe, & Sodian, 1988).

Children's understanding of the modality-specific nature of knowledge has frequently been investigated by presenting them with two objects that feel different (e.g. one is wet and the other dry) but look the same (so no visual cues are available as to the object's state of wet or dryness). Children then observe one puppet 'feeling' the objects and another puppet 'looking at' the objects and are asked which puppet 'knows' that the object is wet/dry (e.g. O'Neill et al., 1992 Studies 1 and 3). Applying a slightly different format to investigate their understanding of the modality-specific nature of knowledge, children have been asked what sensory action they or a puppet should carry out in order to determine a particular characteristic of a given object (e.g. O'Neill et al., 1992; Pillow, 1993; E. J. Robinson, Thomas, Parton, & Nye, 1997). Generally, researchers have concluded that three-year-olds and a sizeable number of four-year-olds have difficulty identifying what types of information can be gained from different sensory modalities, supporting the idea that there is a shift in the developmental trajectory outlined above.

Many studies which explore understanding of the aspectuality of knowledge have investigated the tactual and visual modalities (O'Neill et al., 1992). Less often has the auditory modality been investigated (Mossler, Marvin, & Greenberg, 1976). Even

more rarely have studies explored knowledge of taste and smell. One study did consider all five modalities, including taste and smell (Weinberger & Bushnell, 1994), but there were a number of procedural limitations. Two age-groups were tested on their knowledge about their senses. In the pre-test phase, four- and seven-year-old children were asked to name or touch which body part helped them to touch, taste, smell, hear and see, and were then introduced to the concept of task difficulty. The terms 'easy' and 'hard' were used about a drawing task in order to prepare the children for deciding whether it was 'easy' or 'hard' to find out an item of sensory information when they had, or did not have access to (for example, through blindfolding), an appropriate body part.

In the test phase, three tasks related to the visual, auditory and tactual modalities and their relation to one another: one task involved audition and its relationship to vision, and the remaining two tasks involved smell and taste and their relation to vision. The children were asked to decide whether it would be 'easy' or 'hard' to find out a particular characteristic of a given object if the appropriate sensory organ were used or not used to find out the property. The visibility task will be described as an example. The child was shown two pairs of bags and two plastic keys. The keys differed visually as they had different visual patterning, but they were identical in shape. One pair of bags was made from thin, opaque cloth. A key placed in one of the bags could not be seen but it could be felt. The other bags were made from transparent plastic 'bubble' wrap, and a key placed in these bags could be seen but not felt. The child was told that the researcher would place one key in each bag, and that they would need to find which bag contained the spotted key. The child was then asked to choose which pair of bags would make the task of finding the spotted key 'hard' or

‘easy’ (the *choice response*). As the keys differed visually, they could easily be picked out in the bubble wrap bags but not in the opaque bags.

Next, they were asked to explain why their choice of bags would make the task ‘easy’ or ‘hard’ (the *prediction explanation*). The researcher then placed the keys in the bags that the child had chosen, and the child was invited to find the spotted key and explain how he/she had been able to find it (the *outcome explanation*). Finally, the child was asked to predict whether it would be ‘hard’ or ‘easy’ to find the spotted key if the same two bags were placed in his/her hands while he/she was blindfolded (the *choice response*). The child was asked to try this, and after attempting to find the key whilst blindfolded, asked to account for the cause of their difficulty. Appropriate responses for this task included correct choice of bag in the first instance, when looking at the keys (i.e. opaque cloth for ‘hard’, bubble wrap for ‘easy’), suitable comments regarding the level of difficulty, and explanations referring to the stimulus characteristics and corresponding body parts or perceptual processes (e.g. I can’t/can see the spots on the key).

The visibility task was quite straightforward as were the remaining visual, tactual and auditory elements of the procedure, although a criticism can be made that the task relied on an excessive amount of verbal processing and responding, particularly for the four-year-olds. However, the researchers did not clearly distinguish between smell and taste when the children’s understanding of those modalities was being investigated. Two tasks, termed the ‘false liquid’ task and the ‘any liquid’ task, were administered. In the former, two cups of liquid were presented to the child. Both cups contained water, one mixed with yellow and one mixed with green food colouring.

The green liquid (rather than the yellow, hence the term ‘false liquid’) also contained lemon extract and juice to make it smell and taste of lemon. The child was informed that one cup had ‘drips of lemon’ in it, and was asked to find the cup with drips of lemon (there was no *prediction explanation* in this task), to indicate his/her selection (the *choice response*) and explain his/her choice (the *outcome explanation*). Finally, the researcher asked the child to identify the body part that had helped him/her to choose the cup with lemon in it (the *body part response*).

In the ‘any liquid’ task, the same series of questions was put to the child regarding two new cups of coloured liquid. Notably, the researchers did not specify the colour of the liquid, neither did they state whether both cups contained liquids of the same colour. However, in this case, neither liquid was yellow in an attempt to eliminate a potential visual bias based on the colour of the liquid. Responses demonstrating competence for both tasks included selecting the correct (lemony) liquid, explanations citing smell or taste as the basis for selection, and identifying nose or mouth in the *body part* response.

A number of criticisms can be made about the procedures described above. As has already been noted, the receptive and productive language demands on the children were excessive, and there was little opportunity for the children to manipulate the task materials in response to the task requirements. Most emphasis was on their verbal predictions and explanations. There was also a lack of consistency in the procedures for the different sensory modalities, which makes it difficult to compare performance across modalities. For example, in the visual-tactual tasks and in the auditory task, the children were denied access to visual stimuli in some parts of the tasks, either through

use of a blindfold or an opaque screen but not during the smell-taste tasks. A further inconsistency between the tasks was the omission of the *body part* response from the visual-tactual tasks. The researchers offered no explanation for these irregularities.

In addition to the procedural limitations discussed above, it is difficult to understand why the researchers chose to link audition and vision, touch and vision and smell and taste. They give no explanation for these pairings, and the choices seem rather arbitrary. Separate consideration of each modality would produce clearer results, allowing for comparison of knowledge about each one. If, however, cross-modality links were the focus of the study, then it seems plausible to explore links between vision and the remaining four modalities, given that during times when the other four modalities are active, they are usually simultaneously accompanied by visual information about what is heard, felt, smelt or tasted.

Despite these procedural limitations, it is worth mentioning some key findings to emerge from the data, as they are similar to findings from other studies. Both the four- and the seven- year-olds were well-informed and articulate about the visual modality (see also Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Perner, 1988). More than half the four-year-olds were able to explain their predictions about vision fluently, in line with other findings that by the age of four years, sighted children are aware that using their eyes is a suitable way to obtain certain types of information, and that they appropriately identify seeing as the source of their own or others' beliefs (see also Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Perner, 1988).

Both age-groups overestimated the role of vision as a source of knowledge. Children in the younger group tended to state that they would not be able to learn anything, including non-visual information, about an object while wearing a blindfold. The older children were more knowledgeable about the limitations of vision and the utility of the other senses, but they made a number of errors on the smell/taste tasks, particularly the 'false liquid' task. The researchers concluded that the children relied on visual clues (i.e. the colour of the liquid) when trying to determine which of the two cups contained the liquid with drips of lemon, rather than use valid odour and/or taste cues. This is consistent with the findings of Fabes and Filsinger (1986), who found that three- to five-year-olds tend to rely on visual cues when making odour preference selections.

There is evidence to suggest that children overestimate the role of vision as a source of knowledge generally and not only in the case of taste and smell (Mossler et al., 1976; O'Neill et al., 1992; E. J. Robinson et al., 1997) and this is an issue which will be considered further in Section 2.6. below.

Within the body of research reviewed so far there is a major lacuna. In order to investigate the development of children's understanding of aspectuality comprehensively, it is surely essential to address all five senses within the same study, comparing the ability to *obtain* a particular type of knowledge through a specific modality, and to state *how* they or other people acquire the knowledge, across age-groups and sensory modalities.

Just such an investigation was carried out by O'Neill and Chong (2001). They conducted a study that improved on previous ones in three ways. First, they employed a methodology that systematically tested and contrasted understanding of all five modalities in three- and four-year-old children. Second, their methodology included non-verbal response formats to allow for the possibility that errors would occur because of children's inability to articulate knowledge that was implicit, but not yet explicit or procedural. Third, the task materials allowed children to find out the particular property of a given object through one sensory modality without the need to carry out any possibly confounding transitional actions, for example having to lift up the object in order to see it.

Children aged between three and five years were given two tasks (called here the 'How/Show' task and the 'Mr Potato Head' ('MPH') task) (O'Neill & Chong, 2001). In the 'How/Show' task five scenarios were employed to investigate knowledge and understanding of the five senses. The smell trial is described here as an example. A small, clear plastic bottle of colourless bath oil mixed with essence of strawberry was used. The experimenter said to the child *'Here is a bottle of bubble bath. It is either strawberry bubble bath or lemon bubble bath. Let's find out what kind of bubble bath it is. Do it like this.'* The experimenter modelled the appropriate sensory action, in this instance, leaning forward to smell the top of the bottle. The experimenter did not name the sensory action being performed (in this instance smelling). After the children had copied the action the experimenter asked *'Is it strawberry bubble bath or lemon bubble bath?'* The children were then asked *how* they had found out the nature of the property and finally, were asked to *show* the experimenter how they had discovered the nature of the object property. Thus, the particular property of each

object could only be determined by the use of one sensory modality (e.g. smell). That is, the object supplied no other cues (e.g. colour) that might have facilitated an inference as to the particular property being explored. The children did not need to perform any intermediary action in order to find out the given property of the object (e.g. picking the object up), which again, could potentially have led to confusion about how the information had been gained.

In a second task, which was included in order to provide a second non-verbal route for the children to demonstrate their knowledge, the children were presented with a Mr Potato Head toy sporting detachable ears, eyes, nose, mouth and hands. They were asked to point to the sensory part that Mr Potato Head needed to use to find out the object properties that the children themselves had discovered in the previous game. For example, in the smell trial, the experimenter said *'Here is a bottle of bubble bath. It is either strawberry bubble bath or lemon bubble bath. What will Mr Potato Head need to use to find out if the bubble bath is strawberry bubble bath or lemon bubble bath?'*

Overall, the four-year-olds performed significantly better than the three-year-olds, and they performed significantly better on the Show and MPH questions than on the How questions, suggesting that they benefited from the non-verbal response format. Given that the four-year-olds performed consistently better than the three-year-olds on both verbal and non-verbal response measures, the experimenters concluded that there is a dramatic, qualitative shift in understanding of aspectuality between the ages of three and four years, which cannot simply be attributed to increased verbal ability.

While this methodology elicited much valuable information about young children's understanding of the aspectuality of knowledge, it might have been improved by omitting the researchers' demonstration of how to obtain the sensory knowledge, for example, in the smell trial, by leaning forward to smell the top of the bottle. It would have been interesting to explore at what age children are able to find out a particular property independently.

Notwithstanding this omission, the findings of O'Neill and Chong (2001) suggest that there is a remarkable, qualitative change in children's understanding of aspectuality between the ages of three and four years. What might be the cause of this and later improvements that occur until full understanding is reached?

2.5. Explanations for developmental change in children's understanding about the aspectuality of knowledge

What then occurs or changes between the third and fourth year of life to bring about what O'Neill and Chong (2001 p.814) call a 'dramatic, qualitative shift' in children's understanding of aspectuality? Three-year-olds' difficulties with identifying the source of their knowledge have been explained using evidence from the fields of neuropsychology (e.g. Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Perner, 1990, 1991, 1992) and theory of mind (e.g. Perner, 1991). A third factor, which may be involved in development of understanding of aspectuality, is direct instruction, as it has been suggested that direct instruction can bring about significant improvement in the understanding of five-year-olds (Massey & Roth, 1997).

The evidence from neuropsychology (e.g. Moscovitch, 1995; Rabinowitz, Craik, & Ackerman, 1982; Schacter, 1996) to explain the lack of understanding in three-year-olds and the development of understanding in four-plus-year-olds is favoured by O'Neill and Chong (2001). They suggest that it is immaturity in the frontal lobes of three-year-olds that prevents them from becoming explicitly or procedurally aware of the sources of sensory perceptual experiences, possibly as a result of an inability to process the source simultaneously with the perceptual information. The evidence for immaturity in the frontal lobes being responsible for the difficulties experienced by three-year-olds seems to be quite persuasive. However, if this were the case, one would expect the three-year-olds to perform only at chance levels on O'Neill and Chong's tasks. On the contrary, the performance of the three-year-olds was significantly better than expected by chance.

A number of other studies have found that three-year-olds, while experiencing many difficulties on aspectuality tasks, perform at above chance levels on tasks designed to explore their understanding about how different perceptual modalities provide knowledge about different aspects of objects and the environment, indicating some encoding and recall of source information (O'Neill et al., 1992; Pillow, 1988; Woolley & Bruell, 1996). If the immature frontal lobe theory is correct, then encoding of source information should have an all-or-nothing effect on understanding the sources of sensory perceptual experiences rather than being source-specific. This theory then, does not appear to be able to explain the significantly better understanding of aspectuality demonstrated by four-year-olds in studies such as that of O'Neill and Chong (2001). However, Woolley and Bruell (1996) found that the ability of three-year-olds to identify sources is dependent partially on their familiarity with different

sources, rather than being a global ability that three-year-olds lack but four-year-olds possess. In line with O'Neill et al. (1992) they suggest that because so much information is gained from seeing, three-year-olds develop an understanding of the *association* between seeing and knowing, and this may explain why even they can succeed on simple visual access tasks, but not on tactile (and perhaps other) tasks. However, this does not mean that they have a *causal understanding* of sensory experience (in this case, vision) and knowledge (O'Neill et al., 1992). The immature frontal lobe theory, therefore, might still be feasible.

An alternative position is taken by some researchers, who argue that the ability to identify the source of one's knowledge improves dramatically between the ages of three and four years (Gopnik & Graf, 1988; Wimmer, Hogrefe, & Perner, 1988; Wimmer, Hogrefe, & Sodian, 1988; Woolley & Bruell, 1996). They posit that three-year-olds' difficulties with theory of mind tasks are indicative of a general inability to identify the origins of any mental representation, and the ability to do so at four-years is because of the newly acquired understanding of the mind as representational (Perner, 1991).

While the development of theory of mind is not a key focus for this thesis, it is useful at this juncture to consider the links between theory of mind and understanding of the aspectuality of knowledge. There are two contrasting positions in this debate. The first suggests that an early developmental milestone in the acquisition of theory of mind is the understanding that seeing leads to knowing (Taylor, 1988; Weinberger & Bushnell, 1994), and without that fundamental knowledge, acquisition of theory of mind may be delayed. This of course has implications for children who are blind and

who, because of the lack of first-hand experience of seeing, may be delayed in the acquisition of such knowledge. One plausible prediction is that understanding aspectuality (at least in terms of seeing) is a precursor for the development of theory of mind. On the other hand, the ability to reflect upon the origins of our own mental representations may be a prerequisite for understanding about the aspectuality of knowledge (Gopnik & Graf, 1988), leading to the conclusion that acquisition of at least a basic theory of mind precedes understanding the aspectuality of knowledge. Although it seems evident that the two are linked, it is by no means clear which precedes the other.

Proponents of the first position (i.e. knowledge of aspectuality leads to development of theory of mind) include Massey and Roth (1997) who argue that an important element in the development of a theory of mind is understanding how some types of knowledge are acquired through interactions with the physical world, that is, how the sensory modalities provide data that cause oneself and other people to have mental states about the physical environment (Massey & Roth, 1997). Fundamentally, this entails the development of understanding about the aspectuality of knowledge. Massey and Roth (1997) suggest that this understanding includes four elements of knowledge: the sorts of information available through different sensory modalities (e.g. colour information is available through vision but not taste); the nature and requirements of each sensory modality (e.g. tactile information requires physical contact while vision requires light and line of sight); how information from different modalities is integrated (e.g. using information from one modality to verify, supplement or refute another); and how input from sensory modalities relates to

mental states (e.g. different sensory experiences may generate different beliefs about an event or object).

While Massey and Roth do not specifically propose at what age these four elements of knowledge and understanding emerge, drawing on the developmental pathway put forward by O'Neill, Astington and Flavell (1992) and the research evidence presented above (e.g. Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Perner, 1991; Wimmer, Hogrefe, & Perner, 1988; Wimmer, Hogrefe, & Sodian, 1988) it seems apposite to suggest that the first may be present at between three and four years, at least in terms of seeing, corresponding with Level 1 understanding. At around four to five years of age, corresponding with Level 2 understanding, this knowledge becomes more detailed as children become increasingly sensitive to perceptual phenomena (Flavell et al., 1991). The remaining three elements of knowledge and understanding proposed by Massey and Roth (1997) emerge later, facilitating the more sophisticated Level 3 understanding of aspectuality.

If the proposition that knowledge of aspectuality is a precursor for theory of mind is accurate, then research into acquisition of theory of mind can offer little explanation for how knowledge of aspectuality develops. If, however, proponents of the second position (*viz.* development of theory of mind leads to knowledge of aspectuality) are correct, then, as in the case of the immature frontal lobe theory, at least two patterns should be evident in tasks investigating children's ability to identify sources of knowledge. First, three-year-olds should perform, at best, at chance levels, while the performance of four-year-olds should show a significant improvement. Second, the improvement in the performance of four-year-olds should be global rather than

source-specific, notwithstanding differences in children's familiarity with different sources. The evidence provided by Woolley and Bruell (1996) does not support this stance. They found that three-year-olds are able to encode and recall source information at above chance levels, comparable to the abilities of four-year-old children. Further, their results indicated that the ability to identify sources of knowledge was not global; rather, it depended on the nature of the source involved with children performing well on tasks relating to seeing.

Further research is needed to determine which of these theories can best account for the shift in understanding of aspectuality at between three and four years of age, and also for the increase in knowledge and understanding which takes place up until the age of between six and seven years, when an adult-like understanding is reached. The two theories outlined (i.e. *knowledge of aspectuality leads to development of theory of mind* and *development of theory of mind leads to knowledge of aspectuality*) are not, of course, mutually exclusive, and development could be facilitated by a combination of maturation of the frontal lobes and the development of understanding of the mind as representational. Alternatively, the improvement in understanding could be caused by one or more as yet unidentified factors.

A third position proposes that direct instruction can bring about significant improvement in the understanding of five-year-olds, while not excluding the effect that the factors described above may have upon the initial emergence of understanding of aspectuality at around four years of age (Massey & Roth, 1997). What has emerged from this current review of the literature relating to understanding of aspectuality is that it does not occur as a global achievement; rather, it is source-

specific and emerges firstly in relation to the visual and tactual modalities (Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Sodian, 1988).

It has been suggested that familiarity with sources is what facilitates and refines understanding of how and through which modality sensory information is attained (Woolley & Bruell, 1996). Massey and Roth (1997) examined two aspects of understanding of aspectuality in five-year-old children. They assessed how much children of this age spontaneously understand about the relationship between the acquisition of different sorts of knowledge about the physical world and the different sensory modalities. In addition, they looked at the effect of deliberate instruction, in the form of a specially designed curriculum unit on perception, and how such instruction might be effective in facilitating the development of a more sophisticated and informed understanding of aspectuality. The curriculum intervention avoided a basic pairing between a 'sense' and its associated body parts, for example, we hear with our ears, we smell with our nose. Instead, it focused on how people experience and get information about the world through different modalities. The effect of the unit was evaluated by comparing understanding of aspectuality in a group of five- to six-year-old children, who had been taken through the unit by their classroom teachers over a six-week period, with that of a demographically matched control group, whose teacher had not used any of the materials from the unit. Instead, the latter teachers took the more usual approach to the five senses, emphasising simple pairings between a sense and its associated body part.

In Massey and Roth's (1997) study, children were initially made more aware of the different channels through which sensory information is gained, by the provision of a

sensory-rich classroom environment. Typical examples were a fan blowing, a radio playing and an electric popcorn popper popping. The children were asked to comment on *what* they noticed and *how* they noticed it. Their ideas were reinforced by the use of pictographs to help the class make a chart showing the kinds of things the children noticed and the body parts they used to notice them. Through discussion, the children became aware that although vision is a sense that people tend to rely upon very heavily, other sensory modalities provide a variety of ways to learn about and experience the world.

In the next stage of the intervention, each modality was explored in detail. In order to discover which kinds of information and experiences each provided, the children participated in a series of problem-solving activities designed to isolate a particular sensory system (isolation activities). The targeted system was the only modality that could detect the information needed to solve the problem. For example, the children were given three seemingly identical cups of tea. They were told that one was different, but not told which was different or how it was different. By using their senses the children realised that looking, smelling, listening, touching with their skin, and picking up the cups did not provide any information that enabled them to find the odd-one-out. In fact two drinks were sweet and the other was unsweetened. When they tasted each drink and became aware of the difference in taste, they realized that their tongue was the 'only tool for the task'. This metaphor helped children reflect upon the unique nature of each sensory modality.

In these isolation activities, the children were allowed to explore the stimuli as they chose, but the problems were constrained so that the information relevant to solving

the problem was confined to one modality and the materials were the same in every way except for one feature characteristic: in the case of the drinks, they were identical in appearance, but tasted different.

In the next phase of the unit, the children became 'sense specialists' and used just one nominated sense to come into contact with an object and to say what they could learn about it through that modality. A typical example is that an 'ear specialist' could hear a clock chime but could not tell its colour. In these activities, children had deliberately and actively to ignore sensory information from the other modalities and focus only on the sense of his or her specialism. For example, even though the ear specialist could see, she/he must pay no attention to any visual information and report only on information detected through the auditory modality.

The unit continued with activities that were intended to facilitate the understanding that the sensory systems often work together to give more complete information. Seeking additional sensory information can frequently inform or even alter our beliefs about the environment and objects around us. For instance, the children were presented with a scenario in which some cooking ingredients that looked very similar had been mixed up. These could be sugar and salt, water and white vinegar or bicarbonate of soda and icing sugar etc. During the activity, the children discovered that although two items look the same, exploring them with another modality may reveal differences, and thus their initial beliefs may change.

The much overlooked sense of proprioception, that is the process by which the body can vary muscle contraction in immediate response to incoming information regarding

external forces, was included in the study, so six sensory areas were investigated. The assessment task employed six miniature ‘robots’ each of which was allocated a specific sensory function. The ‘Ear Robot’ could only hear; the ‘Eye Robot’ could only see; the ‘Skin Robot’ could only touch (but could not pick up or manipulate objects); the ‘Tongue Robot’ could only taste; the ‘Nose Robot’ could only smell; and the ‘Muscle Robot’ could only lift things. The children were shown a series of object pairs and were asked whether each robot could or could not by itself discriminate between the pair of objects. For example, to assess understanding of the visual modality two pieces of paper that were identical, except that one was red and the other green, were shown to the child. The researcher then presented each robot, one at a time, and asked, *‘Can the [nose, ear, skin, etc.] robot find out which of these papers is green?’* Choosing the Eye Robot and discarding all of the others was the correct response for the vision task.

The results revealed significant differences between the instructed and uninstructed groups in their ability to attribute different types of sensory information to the appropriate sensory modalities. Instructed children had a mean score of 30.7 out of 36 compared to 25.3 for uninstructed children. The mean number of correct responses for each sensory modality also varied, with the following order from highest to lowest mean scores: tongue, ear, muscle, nose, eye, and skin for both groups. Surprisingly, understanding visual and tactual information proved to be the most difficult for both instructed and uninstructed children. In the case of the visual modality, this was largely because both groups tended to overestimate the kinds of information that could be picked up by vision. With respect to the information that can be perceived

through skin touch, both over- and underestimation errors were made. For both vision and touch, the instructed children made fewer errors than the uninstructed children.

The children who had not received instruction through the curriculum intervention unit were more prone to make a variety of errors across the different modalities and tended to score at near chance on a number of items. Typical examples of the errors that were more frequent among uninstructed children were the beliefs that listening to or touching a picture would divulge what was portrayed in it and that smelling two bowling pins would reveal which of the two was heavier.

The researchers drew a number of conclusions from these results. They pointed out that while many young children do not automatically differentiate clearly between types of sensory information participation in activities such as those in the intervention unit enables children as young as five years to progress toward a more 'scientifically accurate understanding of perception' (Massey & Roth, 1997, p.10). This suggests that a sophisticated understanding of how information is gained from the sensory systems is not a purely maturational process and that relevant focused experiences of the kind utilised in the intervention curriculum unit can produce improvements in children's ability to discriminate between the types of information and experiences available through different sensory modalities.

It is unfortunate that the effect of the curriculum unit was not compared across age-groups. As it stands, it is unclear whether such instruction, presented to children younger than five years, would bring about the same sorts of improvements, or

whether increasing maturity of the frontal lobes and theory of mind are necessary prerequisites. Future research is needed to address these additional questions.

The tendency of sighted children to overestimate the role of vision has been reported repeatedly in the preceding sections. The next section will examine this phenomenon, and put forward some possible explanations.

2.6. Sighted children's overestimation of the knowledge to be gained from seeing

A number of studies (e.g. Fabes & Filsinger, 1986; Massey & Roth, 1997; Mossler et al., 1976; O'Neill et al., 1992; Pillow, 1993; E. J. Robinson et al., 1997; Weinberger & Bushnell, 1994) have shown that young sighted children frequently over-estimate the knowledge to be gained from seeing.

Mossler et al. (1976) used a privileged information paradigm to investigate young children's ability to isolate types of knowledge to be gained from individual sensory experiences. The researchers presented children aged three, four and five years with both visual and auditory parts of a video-taped story. They were questioned about their mother's knowledge of both parts after she had received only the visual part. Ninety-five per cent of the three-year-olds thought that their mothers had knowledge of the auditory part of the story; 40 per cent of the four-year-olds thought the same and even some five-year-olds (15%) made the same error.

Children aged between three and six years frequently judged that a puppet could get information about an object's non-visual properties (for example, 'squishiness') by looking at the object (O'Neill et al., 1992). When asked how the puppet 'knew' that

the object was hard, or soft, a standard reply was “Because he’s looking.” The response of one child aged four 4;7 was, “Why? Because he’s looking. That’s why he knows it’s hard.” When asked why the puppet that was feeling the objects didn’t know how they felt, children commonly responded, “Because he’s feeling”, and one six-year-old went so far as to say, “Because feeling doesn’t tell you anything!” Robinson, Thomas, Parton & Nye (1997) reported similar results with children aged four to nine years.

This pattern of overestimating the discriminations that can be made visually was more common among the uninstructed children (50%) than the instructed children (20%) of whom showed the pattern in the study carried out by Massey and Roth (1997) reported in the previous section. Thirty-five percent of all children tested showed a pattern of saying that the ‘Eye Robot’ could make all or almost all (five or six out of six) of the discriminations tested. One child echoed the beliefs of many of his peers when he stated: ‘You can tell anything if you have eyes.’

These findings demonstrate the tendency of sighted children to over-estimate the role of vision in the acquisition of sensory information. Why are they so susceptible to errors of this type? There is no question that young children have an *implicit* ability to explore the environment using all their senses in appropriate ways. They instinctively direct their eyes to get better focal vision, turn their heads in order to locate the source of a sound more accurately, or move a toy close to their ear to listen to the sound it makes. They bring an object close to their face or lean forward, sniffing, in order to detect smell, explore objects manually to get texture, proprioceptive, temperature, and pressure information, etc. and tentatively place a previously un-tasted food into their

mouths to discover whether or not they like the flavour. Massey and Roth (1997) speculated that the proficient, automatic ability to attain sensory data may be responsible for some of the problems that children experience about the information from the visual and, although less frequently observed, tactual modalities:

When we examine something closely in everyday circumstances, we are often seeing its visual properties, feeling its weight, experiencing its surface texture and temperature, hearing any noise it makes, and so forth *all at the same time*. A child who knows to “pick it up and look at it” may require no more sophisticated understanding of perception than that to achieve good conditions for perceptual input for an object of interest. (p.10).

This explanation is persuasive, as it also accounts for sighted children’s confusion about information to be gained through touch. This is less straightforward though, as some studies report overestimation and others underestimation of the role of touch. For example, O’Neill et al. (1992) reported that three- and four-year-olds often chose feeling as the best mode by which to find out a visual property (e.g. the colour of a football). Both over- and underestimation of touch errors were made by the five-year-olds in Massey and Roth’s (1997) study. A large majority (71%) of the total sample of children did not think touching would reveal the difference between glue and hand lotion, both of which were unscented and looked identical, and 39 per cent considered that it was impossible to differentiate between sandpaper and waxed paper by touching them. In contrast, 29 per cent of the children claimed that touching the green and red papers would reveal which was green, and 26 per cent thought that touching the two sweets would distinguish the sweet one from the sour one.

A similar approach is taken by Robinson et al. (1997) in their attempts to explain the overemphasis on vision, although they avoid the question of why there is also an observed tendency to overestimate the capacities of the tactual modality. Knowledge about the visual modality as a source of informational access (i.e. seeing = knowing) is the first to emerge (Pillow, 1989; Pratt & Bryant, 1990; Wimmer, Hogrefe, & Perner, 1988), preceding knowledge of the other modalities, suggesting that young sighted children are particularly attuned to visual information. Robinson et al. (1997) proposed that it is possible that the over-estimation of the role of vision in the acquisition of knowledge in young children aged three years and above, is a result of the persistent application of an heuristic containing the association between seeing and knowing, in the absence of other heuristics or rules.

2.7. Chapter Summary

Chapter Two presented an overview of the literature to date relating to the development of understanding of the aspectuality of knowledge in sighted children. What O'Neill and Chong (2001) describe as a 'dramatic, qualitative shift in understanding of aspectuality' (p.814) occurs between the ages of three and four years, and the main approaches to explaining this phenomenon, which attempt to explain how development of understanding occurs were outlined. Evidence to support claims was drawn from the field of neuropsychology and from the literature on children's theory of mind.

Two major weaknesses were identified with both these approaches. First, three-year-olds should perform, at best, at chance levels on tasks that measure their ability to identify the source of their own and others' knowledge, while the performance of

four-year-olds should show a significant improvement. Second, the improvement in the performance of four-year-olds should be global rather than source-specific. Evidence discussed in this chapter suggests that three-year-olds' performance varies depending on the informational source and is comparable to that of four-year-olds for some sources. Further, the ability to identify informational sources does not seem to be a global achievement, and depends again upon the informational source in question. Specifically, awareness of the visual modality as a source of informational access is the first to emerge, preceding knowledge of the other modalities, suggesting that young sighted children are particularly attuned to visual information.

However, when considered in the context of the developmental trajectory posited by O'Neill et al. (1992), this simply provides evidence for the first (associative) stage of understanding of the aspectuality of knowledge. In this stage, sighted children *associate* seeing with knowing, but this does not mean that they have a *causal understanding* of sensory experience (in this case, vision) and knowledge. Thus, the rationale provided from neuropsychology and theory of mind research may still be feasible.

A third view, while not excluding the effects of the maturing frontal lobes and the increasing sophistication of children's understanding of mind, proposed that direct instruction in the form of relevant focused activities can bring about significant improvement in five-year-olds' understanding of aspectuality (Massey & Roth, 1997).

The early awareness of the link between seeing and knowing is of crucial importance to this thesis, because it raises questions about how congenitally blind children, who

are unlikely to attain this awareness, may develop an understanding of aspectuality. With this in mind, the discussion turned at this point to the tendency of young sighted children to overestimate the knowledge to be gained from seeing. The implicit, efficient ability of young children to obtain sensory data is believed by some (e.g. Massey & Roth, 1997) to contribute towards the problems that sighted children experience when making judgments about information from the visual and, although less frequently observed, tactual modalities.

Robinson et al. (1997) propose that it is the persistent application of an heuristic containing the association between seeing and knowing, in the absence of other heuristics or rules, that is responsible for the over-estimation of the role of vision in the acquisition of knowledge in young children aged three years and above.

This chapter has drawn attention to an important issue. In order to investigate the development of children's understanding of aspectuality comprehensively, it is necessary to address all five senses, within the same study, considering children's ability to obtain a particular type of knowledge through a specific modality, and to demonstrate or explain how they or other people acquire the knowledge, across age-groups and sensory modalities. To date, only one study (O'Neill & Chong, 2001) has attempted to do this.

The first of the empirical studies, reported in Chapter Seven, tackles this issue, and attempts to discover at what age sighted children demonstrate an explicit understanding of the aspectuality of knowledge that is consistently accurate across all five sensory modalities.

The findings reported in this chapter have a number of implications for congenitally blind children, in particular, whether the absence of vision affects development of understanding about aspectuality, and if so how? In the next chapter, these questions will be considered.

CHAPTER THREE

BLIND CHILDREN'S UNDERSTANDING OF THE ASPECTUALITY OF KNOWLEDGE

3.1. Introduction

In the previous chapter, the development of understanding of the modality-specific nature of knowledge, or *aspectuality* (Dretske, 1969; Perner, 1991), in sighted children was considered. The focus now turns to the same area of development in congenitally blind children with no other physical or cognitive impairments.

The following questions concerning aspectuality emerge from the account presented in the previous chapter. Does lack of vision affect the developmental pathway of understanding of aspectuality, and if so, how? Will the proposed causal factors for developmental change in sighted children's understanding of aspectuality (i.e. development of theory of mind, increasing maturity in the brain and direct instruction) suffice to explain development of understanding in congenitally blind children? If so, how; and if not, what other explanations can be offered? Finally, in relation to sighted children's over-estimation of the role of vision in the acquisition of knowledge, the absence of visual experience makes it unlikely that blind children would over-estimate the role of vision. Is it reasonable to speculate though, that due to their reliance on sound and touch, they might over-estimate the role of one of these modalities in the acquisition of knowledge. The following sections address these questions. Some methods for investigating understanding of the aspectuality of knowledge were presented in Chapter Two. The question of whether it is appropriate or even possible to measure the development of understanding about aspectuality in children who are

blind using similar methodological paradigms as those used with their sighted peers will be addressed in Chapter Six, where methodological issues are considered in detail.

3.2. What do blind children understand of the aspectuality of knowledge?

There is a dearth of literature about the development of understanding of aspectuality in congenitally blind children. Given that there is some evidence to suggest that awareness of the association between seeing and knowing is an early milestone in development in this area (e.g. O'Neill et al., 1992; O'Neill & Gopnik, 1991; Pillow, 1989; Pratt & Bryant, 1990), it is unlikely that blind children's understanding will develop in an identical way to that of their sighted peers. In the developmental pathway suggested by O'Neill et al. (1992), Level 1 (the associative stage) understanding is limited to the association between seeing and knowing. What is the equivalent stage for children who are blind? It seems unlikely that the association between seeing and knowing will emerge first for them. Could it be that the associative stage, given blind children's dependency on the tactual modality for environmental information, will consist of understanding the relationship between feeling/touching and knowing?

There is no research evidence at this time to answer these questions. However, it is possible to argue that the very nature of the information available to blind and sighted children is different, and necessitates a different *route* to the understanding of the environment and objects, and perhaps, as Lewis (2003) suggests, a different *type* of understanding. For sighted people, rich information is gathered from simply scanning the visual field, and objects and events are perceived as part of a synthesised, coherent

whole. Only rarely do sighted people break down their perceptual experiences of an object into discrete parts. For example, a swan is instantly recognisable by its colour and shape, and some cue about texture is given by the appearance of the feathers. As its beak opens and closes, there is a visual stimulus, accompanying the sound heard as the swan squawks. There is no need for a sighted person to collect visual, then tactual, then auditory information separately; the processing of the information is seemingly simultaneous and the separate parts are fused effortlessly into a recognisable entity or scenario, which is sometimes referred to as a 'merging of the senses' (Stein, 1993). The abundance and effortless availability of information from the visual modality though, may actually prevent young sighted children from isolating *types* of sensory information, and identifying exactly how that information is known, as suggested by Massey and Roth (1997) and Robinson (1997). So, although they associate seeing with knowing, they are not necessarily able to identify exactly what is and what is not possible to know through visual access alone.

Conversely, people who are blind are likely to access information in a much more discrete and sequential manner (Hatwell, Orliaguet, & Brouty, 1990). Their access to some information is of necessity slower because much of it is gathered through tactual rather than visual exploration. More effort is required when collecting sensory information without the benefit of a visual glance, and then synthesising that information in order to make sense of it (Hatwell et al., 1990). Similarly, auditory information is different from visual information: vision is uninterrupted (unless one chooses to look in a different direction, or is plunged into sudden darkness), while sounds are rarely continuous, tending rather to stop and start.

This sequential processing of sensory information might enable blind children to identify more easily the modality through which they, and other people, gain sensory-specific knowledge, and/or to have a greater awareness of the different modalities. This is not to say that they are particularly *sensitive* to the information gained through their intact modalities, but that many studies support the hypothesis that they make better *use* of information from the other modalities than do their sighted peers. For example, in a study of blind and sighted five- to 17-year-olds, although levels of sensitivity to 25 different odours were not found to be different in the two groups, the blind participants were able to name more of the odours they smelled than were the sighted participants (Rosenbluth, Grossman, & Kaitz, 2000). Lewis (2003) comments that because blind children cannot discriminate between common substances and materials visually, they possibly pay closer attention to their smell than do sighted children, and are consequently more adept at naming them.

Will the proposed causal factors for developmental change in sighted children's understanding of aspectuality suffice as an explanation for development of understanding in congenitally blind children? If so, how; and if not, are there any other possibilities? These are questions that will be explored in the next section.

3.3. Influences upon the development of blind children's understanding of the aspectuality of knowledge

Three possible explanations for developmental change in sighted children's understanding of the aspectuality of knowledge were offered in Chapter Two (Section 2.5.). First, it was suggested that the improvement in ability to encode and/or retrieve source memories at around four years of age may be due to increased maturity of the

frontal lobes (O'Neill & Chong, 2001). There is no published evidence to suggest that maturation in the frontal lobes is delayed or qualitatively different in congenitally blind children, so if this is the only influence on development of understanding about the aspectuality of knowledge, then blind children's understanding of aspectuality should reflect that of their sighted peers.

Second, evidence drawing from the literature on children's developing theory of mind was presented, and the newly acquired understanding of the mind as representational at around four years of age was raised as a possible explanatory factor (Gopnik & Graf, 1988; Wimmer, Hogrefe, & Perner, 1988; Wimmer, Hogrefe, & Sodian, 1988). While there are some inconsistencies in the findings about blind children's understanding that other people may have knowledge and beliefs that are different from their own, the general consensus is that blind children do come to understand mental states but that this occurs later than it does in sighted children (e.g. Green, Pring, & Swettenham, 2004; McAlpine & Moore, 1995; Minter, Hobson, & Bishop, 1998). Thus, if developments associated with theory of mind are crucial to understanding of the aspectuality of knowledge, then it is probable that blind children will be delayed in the development of this understanding.

Third, while not excluding the effects of the maturing frontal lobes and the increasing sophistication of children's understanding of mind, evidence was presented to demonstrate that direct instruction in the form of relevant focused activities can bring about significant improvement in five-year-olds' understanding of aspectuality (Massey & Roth, 1997). There is no reason to suppose that children who are blind, providing they have no other cognitive or physical impairments, are any less likely

than their sighted peers to benefit from the sort of intervention applied by Massey and Roth (1997) and reported in Section 2.5. However, because they cannot see, blind children obviously could not benefit from the direct experience of vision enjoyed by sighted children, and so would be unlikely to acquire the same breadth of knowledge about the visual modality.

A large body of empirical findings suggests that sighted children tend to overemphasise the role of vision in the acquisition of sensory information. In the following section, it is argued that while blind children are unlikely to overemphasise the importance of visual information, it is possible that they may exhibit an equivalent bias in one of their four intact modalities.

3.4. Overestimation of the role of a specific sensory modality in blind children

In the absence of visual experience, it is unlikely that blind children would overestimate the role of vision in the acquisition of knowledge. Drawing on the suggestion raised above that young sighted children possibly apply an heuristic containing the association between seeing and knowing in the absence of other heuristics or rules, it seems feasible to propose that there may be an equivalent bias in the developing understanding of blind children. Woolley and Bruell (1996) argue that young children's ability to identify sources is partially dependent on their familiarity with different sources, rather than being a global ability that three-year-olds lack but four-plus-year-olds possess. Blind children, once they are mobile, physically examine their world primarily through the sense of touch. So it is feasible that, should a similar bias exist, it would be toward the tactual modality. Alternatively, the bias could be toward the auditory modality. Studies have shown that blind children make more efficient use

of auditory information, such as environmental sounds and speech, than do their sighted peers (Ashmead, Wall, Ebinger et al., 1998). Very young blind children use auditory information to find out about objects (Sampaio, 1989), and older blind children use sounds to help them to navigate through the environment (Ashmead, Wall, Eaton et al., 1998). Also, the role of auditory material, including speech, is fundamentally important for the development of self-identity in blind children (Junefelt, 2004). Thus, blind children use auditory information and experience to construct and make sense of their world, and it is unsurprising that there is plenty of evidence to suggest that blind teenagers have more efficient auditory perceptual processing skills than do sighted young people of the same age (Naveen, Srinivas, Nirmala, Nagendra, & Telles, 1998a, 1998b). Furthermore, it has been found that blind people – and interestingly, also musicians – have increased excitability in those neural systems associated with auditory processing, than do sighted people and non-musicians (Roder & Rosler, 2003).

It is possible then, that if blind children, in tandem with sighted children, overestimate the role of a single modality in the acquisition of sensory information, the bias may be toward the tactual or auditory modality.

3.5. Chapter Summary

This chapter proposed that the absence of vision makes it unlikely that blind children's understanding of aspectuality will develop in an identical way to that of their sighted peers, and documented a number of tentative proposals. Sighted children, in the associative stage of development, are aware of the relationship between seeing and knowing. It was suggested that any associative stage for blind children might

consist of awareness of the relationship between feeling/touching and knowing, although it is by no means clear that an equivalent stage exists for congenitally blind children.

It was also argued that because blind children gather sensory information more sequentially, and consequently, more slowly than do sighted children, they may be more able to identify the modality through which they, and other people, gain sensory-specific knowledge, and/or have a greater awareness of the different modalities. However, it is likely that their understanding of the capacities and limits of the visual modality will be less sophisticated than that of their sighted peers.

The sources of influence on development of understanding of aspectuality in blind children were discussed. It was suggested that if blind children are delayed in their understanding of mental states, there could be a corresponding delay in their understanding of aspectuality. However, there is no reason to suppose that maturation of the frontal lobes is delayed in congenitally blind children, or that they are any less likely than their sighted peers to benefit from interventions of the type applied by Massey and Roth (1997) reported in Section 2.5.

Finally, it was proposed that, in the absence of visual experience, blind children might tend to overestimate the role of touch, or possibly audition, in the acquisition of sensory information.

The first of the empirical studies, reported in Chapter Seven, tackles some of these issues by investigating the age at which congenitally blind children demonstrate an understanding of the aspectuality of knowledge that is consistently accurate across all

five sensory modalities. It also explores whether congenitally blind children demonstrate better understanding of the tactual or auditory modalities than of the other three modalities, and attempts to discover whether congenitally blind children demonstrate a bias toward overestimating the knowledge that can be gained from a particular modality that is equivalent to sighted children's overestimation of vision.

The importance of vision in the development of knowledge about aspectuality has been documented in Chapters Two and Three. Vision is also a key component in the development of perspective-taking abilities (Flavell et al., 1968), and in the next two chapters pertinent research findings will be examined.

CHAPTER FOUR

THE DEVELOPMENT OF PERSPECTIVE-TAKING IN SIGHTED CHILDREN

4.1. Introduction

Perspective-taking is considered to be a major landmark in sociocognitive development, and can be defined as the ability to understand the perceptual, emotional, cognitive or motivational reactions of other persons, even when these are different from one's own (Silbereisen, 1995). Perceptual perspective-taking, that is, imagining how the environment is perceived through the sensory modalities from the position of another person, is the first type to emerge, and visual perspective-taking is the most widely researched. There are at least two components to visual perspective-taking: first, it requires that children understand something about the physical factors that influence visual perception (e.g. direction of eye gaze, position of viewer, presence of occluding obstacles, etc.), and second, that they possess at least a rudimentary theory of mind in order to assume mentally the position of another person. Thus, the ability to take the visual perspective of another person demands a certain level of developmental maturity (Cox, 1986).

4.2. What do sighted children understand about visual perception and perspective-taking?

An early measure of perspective-taking ability in children was the famous three mountains task (Piaget & Inhelder, 1956), in which children aged between four and 12 years were asked to choose a picture of how a doll, placed in a variety of positions would view a three dimensional display of three model mountains from different

perspectives. Four- and five-year-olds frequently chose the view that they could see themselves (rather than the doll's view), and it was not until the age of eight to nine years that children were able to take the perspective of the doll. Piaget concluded that children below the age of eight years were unable to take the perspective of another person, and claimed that this was a product of young children's egocentricity (self-centredness).

However, many criticisms have been made of the three mountains task, mainly that it is a particularly artificial task for young children, many of whom are unfamiliar with model mountain ranges, and that therefore, the task is unlikely to elicit their actual knowledge and ability (Donaldson, 1978). Later studies (e.g. Borke, 1971; Donaldson, 1978) demonstrated that even three- and four-year-olds can take the visual perspective of another person when the materials are more familiar and the task itself less arbitrary.

In addition to the problems described above, Borke (1971) raised a number of further criticisms of the task: it was not motivating or interesting; the response format of selecting a picture (itself a representation) of how the view would look might be difficult for many young children; and because the task was so unusual, practice with the materials may have improved the performance. Borke repeated the three mountains task with three- and four-year-old children using Piaget and Inhelder's (1956) basic format, but changed the context, by using familiar characters and environments (e.g. a Sesame Street character doll, a lake with a boat, a horse, a cow and a house). She used four experimental displays: a practice display, Piaget's three mountains display, and two others, one simple and one complex. She also avoided the

use of pictures in the response format and used instead a revolving turntable, upon which was a replica display. The child was asked to rotate the turntable to give the Sesame Street doll's view. Borke also gave the children some initial practice with the task materials. The results demonstrated, as Borke had predicted, that the task itself had a fundamental influence on the children's success. Many of the children were able to take the perspective of another when faced with even the most complex display, and furthermore, the use of the rotating turntable proved to be a much easier response option for the children than the selection of a picture. However, despite the more appropriate response format and the benefit of a practice session, when the children were faced with the three mountains display, they reverted to a more egocentric perspective, although they still performed at above chance levels.

Many researchers have claimed that an awareness of visual perception plays a central role in infants' and toddlers' developing cognition (Corkum & Moore, 1998; McGuigan & Doherty, 2002; Woodward, 2003), and evidence suggests that even at three months of age infants prefer to look at eyes than other facial features (Maurer & Salapatek, 1976), at people whose eyes are open (Batki, Baron-Cohen, Wheelwright, Connellan, & Ahluwalia, 2000), and successfully follow eye gaze direction alone (in the absence of corresponding head movements) when the eyes are isolated from the face (Hood, Willen, & Driver, 1998). These findings suggest that infants are attuned to the looking behaviours of others, maybe because potentially this supplies information about the other's experience and reference (Dunphy-Lelii & Wellman, 2004). Alternatively, of course, with the exception of following eye-gaze, it could simply be that they are attracted to the contrast that eyes provide.

Sighted children of preschool age have some understanding of the visual perspectives of other people. For example, by the age of two years, sighted children appear to know that for an object to be visible to an observer, that object should not be occluded from them (Masangkay et al., 1974). By the age of three years, children know that the observer's eyes must be open, and facing in the direction of the object (Lempers, Flavell, & Flavell, 1977), and that large intervening objects or screens block vision (Flavell et al., 1991). They also have some understanding about the effects of distance on vision (Bigelow, 1991).

However, although the view that young children are sophisticated in their understanding of the visual perspectives of others has a certain plausibility, a number of studies suggest a more complex story, and there is a body of evidence to suggest that young children's understanding of visual perception is limited. For example, some studies suggest that three-year-olds have not yet learned that lines of sight must *always* be straight (Boydell, Campbell, & Doherty, 2003; Flavell et al., 1991), and it is not until the age of five years that children show some command of this rule. Furthermore, (see also Chapter Two), sighted four-year-olds do not fully understand the limits of what can be known through vision, and may find it problematic to decide whether vision can give information about visual properties such as colour, or tactile properties such as weight or texture (O'Neill & Chong, 2001; O'Neill & Gopnik, 1991). Although some studies have suggested that very young children are sensitive to eye gaze, and can predict where a person is looking by observing eye gaze direction (e.g. Hood et al., 1998), others (e.g. McGuigan & Doherty, 2002) found that many young three-year-olds were unable to determine where an adult was looking using eye gaze alone as a cue. Much more useful cues are body posture, head direction and

overall demeanour. It appears then, that although sighted children of preschool age have some understanding of the visual perspectives of other people, this understanding is limited. Their understanding of the rules and conditions of vision (i.e. line of sight, intervening obstacles, adequate light, head orientation etc.) increases with cognitive and conceptual development.

How do children become competent in their ability to take the visual perspective of another person? What do they need to be able to understand in order to succeed on tasks that explore their understanding of other people's perspectives? The following section provides an account of the four-stage developmental path proposed by Flavell (1978).

4.2.1. A developmental approach to understanding visual perception and perspective-taking

Children gradually develop an understanding that other people see things as they themselves do and that the content of another person's visual experience can be deduced from a number of environmental and social 'pointers' (Flavell, 1978). Environmental pointers include the presence or absence of occluding objects between the viewer and the viewed, direction of eye gaze and relative positions of the viewer and viewed. Social clues involve bodily gestures, facial expressions, posture and general demeanour. Flavell suggests that this gradual development emerges in four discrete levels.

According to Flavell's theory, at Level 0 the child is unable to represent or anticipate the visual experience of another. However, during this period, infants (birth to two

years of age) do have a sensitivity to the looking behaviours of other people (see for example Batki et al., 2000; Hood et al., 1998; Maurer & Salapatek, 1976 cited in Section?). There is also substantial evidence to suggest that by the age of 18 to 24 months, infants develop an increasing awareness that 'looking' is a relation between the looker and the object, and that when a person gazes at an object, the gaze is an action by the person, directed at the object (e.g. Butler, Caron, & Brooks, 2000; Corkum & Moore, 1998).

Despite this sensitivity to eyes and eye gaze, it appears that younger infants, rather than appreciating that an observer is actually looking at an object, simply have learnt that when they follow a person's eye gaze, they will see something of interest (Moore & Corkum, 1994), and their representation of the looking event possibly does not include the person or the person-object relationship at all, simply the object (Butterworth & Jarrett, 1991). If this is so, then the gaze of another person simply draws the attention of the infant to the object under observation. Support for this hypothesis was provided by Butler, Caron and Brookes (2000) when they investigated gaze following in 14- to 18-month-olds. The infants faced a researcher who conspicuously turned his head and eyes to look towards two immobile visual targets, one placed to the left and one to the right a few feet away. There were three conditions. In the no-screen condition, there were no obstacles to stop the researcher from seeing the targets. In the screen condition, opaque screens were inserted between the researcher and the target. The screens were positioned in such a way that the infants could still see the targets, but the researcher clearly could not. In the window condition, each screen contained a large transparent widow that allowed the researcher to see the visual targets, as in the no-screen condition. The infants were

able to see through the window screen and additionally, the researcher waved at the infants through the window in order to draw their attention to its transparency.

The authors reasoned that if the infants did not appreciate the referential nature of looking and its line of sight requirements, then they would turn equally to follow the eye gaze in all three conditions. Conversely, if they understood the connection between the viewer and the object, they would look towards the targets most in the no-screen and window conditions when the researcher could see the objects, and least when the objects could not be seen (the screen condition). Fourteen-month-olds showed a mixed pattern of responses. They turned less in the screen condition than in the no-screen condition, but nevertheless, turned at well above chance levels in the screen condition. Interestingly, they turned more often in the screen condition than in the window condition. In contrast, 18-month-olds turned much more often in the no-screen and window condition than in the screen condition, suggesting that they understood better the link between viewer and object. Strikingly, 35 per cent of the 18-month-olds strained forward to try to see what was inside the screen when the researcher gazed there, presumably to discover what the researcher was looking at. Less than five per cent of the 14-month-olds did this. This implies that, despite their ability to follow eye gaze, infants under the age of 18 months are unable to appreciate the referential nature of looking, while by the end of infancy (18 months to two years), understanding of vision as person-object connectedness is in place. It is important to note however, that while infants less than 18 months old are unable to represent or anticipate the visual experience of another person, they are interested in and sensitive to the looking behaviours of other people (see also Woodward, 2003).

The next stage, according to Flavell's (1978) theory occurs at between two and four years of age, and Level 1 understanding develops. At this level, the child shows an understanding that others as well as the self see objects, and is also able to infer correctly what objects others can or cannot currently see if provided with adequate cues. However, although sighted children of this age understand that an *object can be seen*, they do not appreciate that an object seen simultaneously by both themselves and another person is *seen differently* from different spatial positions.

In order to assess Level 1 knowledge, Masangkay et al. (1974) held a card vertically between a child and a researcher. The card had a picture of a cat on one side and a picture of a dog on the other. The child was asked to say which animal the researcher could see. Three-year-olds had no difficulty, when looking at the cat picture themselves, to report that the researcher could see the dog. However, when a picture of a turtle was placed horizontally on the table, so that it was right-side-up from the child's perspective, but upside-down for the researcher, three-year-olds correctly stated that the turtle was right-side-up from their own perspective, knew that the researcher could see the turtle, and that if he (the researcher) covered his eyes, he could no longer see it (demonstrating Level 1 understanding). Only about one third of them demonstrated the second, more sophisticated understanding of seeing (Level 2) by consistently attributing the opposite orientation (i.e., upside-down) to the researcher, providing evidence that there is a genuine robust difference between the two levels of understanding.

During Level 1 understanding, at the age of two-and-a-half to three years, children act as though they are implicitly aware of the following four conditions that must be in

place for vision to be possible: at least one of the observer's eyes must be open; the eyes must be aimed in the general direction of the visual target; there must be no occluding objects between the observer and the visual target; and what the child sees has no bearing upon what the observer sees (Flavell, 1978; Lempers et al., 1977).

Implicit knowledge of these imperatives enables children between two-and-a-half and three years to allow others access to vision (Flavell, 2004). For example, they are able to point to a target in order to bring it to the attention of another person, they move or reorient an object so that it can be seen, they ask a person to open their eyes in order to see an object etc. This knowledge also enables children of this age to prevent vision by moving a visual target behind an occluding screen or object or by persuading a person to turn away or close her eyes. They can also predict whether or not a person can see a target by weighing up whether or not the four seeing conditions pertain.

At around four years of age, Level 2 understanding begins to emerge, and is usually complete by age seven. In this stage, the child understands not only that people can see objects, but also that they can have differing visual experiences of the same object when looking at it from different positions. Thus, they can make inferences about how visual experiences may differ between themselves and another person. For example, that an object with sides that are heterogeneous in appearance, such as a doll, will look different to another person if they view it from the opposite side from the child him/herself, or that a picture of a tree placed flat on a table, viewed right-side-up from their own perspective, will appear upside-down to a person sitting opposite them (Masangkay et al., 1974).

Although there is a body of evidence to suggest that Level 2 understanding begins to emerge at around four years of age in sighted children and is complete by the age of seven years (Miletic, 1995), studies have mainly used tasks that demand the description or selection of an alternative face of an object viewed by an observer positioned so that he/she has a different perspective to the child. Whilst methodology of this type can reveal basic knowledge about how an object looks to another person, it only provides evidence of knowledge of line-of-sight rules. There is a lack of research about the development of explicit knowledge about the conditions under which vision is blurred or indistinct (for example, when light is poor), or that embedded figures may require visual search because they blend with the background, or that an object looks clearer the nearer the viewer is positioned to it. One study that did explore this latter rule found that by four-and-a-half years of age, sighted children understand that one observer positioned close to a small object will be able to see it better than a second observer positioned further away on roughly the same line of sight (Flavell, Flavell, Green, & Wilcox, 1980). Four-year-olds are also more aware than three-year-olds that the apparent size and shape of objects alter with changes in its distance and orientation, with respect to the observer (Pillow & Flavell, 1986). These examples provide evidence for a developing interest and attentiveness during the preschool period to the way things appear perceptually (Flavell, 2004).

Level 3 understanding is usually achieved by the age of ten years and comprises reflective and abstract knowledge about visual experiences and actions. When this stage is achieved, the child appreciates that intelligence, past experience, attention and mood influence the perception of an object, person or scenario.

A number of studies have attempted to map out the emergence of Level 3 understanding. For example, Miller and Bigi (1977) asked children to select objects with which to surround a red triangle in a visual search task, in order to make it harder to find. Children younger than eight years tended to choose many objects, regardless of colour or shape, but those aged eight or nine years were much more selective in their choices, opting for other red triangles of various sizes, demonstrating an understanding that in addition to distracting from the target by the use of multiple objects, similar objects make the target blend into the background and less obviously visible (Miller & Bigi, 1977).

In a related study, children aged seven to eight years, and nine to ten years as well as adults were asked, “Can somebody look at something and not see it?” The youngest children tended to say no, with no justification given. The nine- to ten-year-olds said yes, because of a vision or lighting problem, while adults said yes, because attention was elsewhere (Fabricius, Schick, Prost, & Schwanenflugel, 1997).

It appears then, that Level 3 perspective-taking ability emerges between the ages of around seven and 11 years, with children gradually developing an adult-like appreciation of the psychological factors that influence vision.

There is, then, a substantial body of research to support Flavell et al.’s proposal that understanding of the visual perspectives of other people develops through four distinct levels. How can the development of perspective-taking be explained and what factors affect children’s understanding? The next section turns to these questions.

4.2.2. Causes of development in understanding of visual perception and perspective-taking

Progression from Level 0 to Level 1 Perspective-taking requires that a child understands something about the physical factors that influence visual perception and also that they possess at least basic theory of mind understanding in order to mentally assume the position of another person (although some researchers (e.g. Gopnik et al., 1994) take an alternative position, which will be described later in this section). For sighted children, a general age-related increase in awareness of the processes and experiences of visual perception informs understanding of what they can and cannot do visually. For example, three-year-old sighted children do not demonstrate that they have explicit knowledge that lines of sight must be straight (Flavell et al., 1991), although even infants demonstrate that they can infer where a person is looking by looking at the person's eyes (Butterworth & Cochran, 1980), probably by projecting a straight line of sight outwards from the viewer's eyes. Furthermore, three-year-olds know from experience that they cannot bend their sight around large objects, as is demonstrated by their performance on many perspective-taking tasks (Flavell et al., 1978; Hughes & Donaldson, 1979). However, while these studies make evident an *implicit* understanding that lines of sight are straight by the age of three years, other studies (e.g. Boydell et al., 2003; Flavell et al., 1991) suggest that this is not explicit knowledge of a 'hard-and-fast' rule; that is, young children *expect* lines of sight to be straight, but do not *explicitly* appreciate that lines of sight are *always* and *unavoidably* straight.

Flavell and his colleagues (1991) speculated that an increasing sensitivity to perceptual phenomena, combined with a growing capacity to recognise and reflect

upon the straightness, as opposed to non-straightness, of lines, is what helps children to attain an explicit understanding that lines of sight must always, of necessity, be straight based upon their own visual evidence. By the age of five years, sighted children demonstrate some understanding of the straight-line rule (Flavell et al., 1991).

Level 1 understanding then, in sighted children, develops as children use their own visual experiences to form generalisations and visual rules to predict what others can or cannot see. However, relevant experience, even when that experience consists of actually giving children the correct answers to Level 2 questions, does not facilitate Level 2 thinking in children who are still at Level 1 (Flavell, Everett, Croft, & Flavell, 1981). Level 2 perspective-taking demands that the child carries out internal computations such as mental rotation, or imagining oneself at the other observer's position (Flavell, 1978), in addition to an understanding of the relationships between inter-observer positions and knowledge of aspects of an object from different positions in order to apply the appropriate heuristic or rule (Gzesh & Surber, 1985). This requires a sophisticated use of cognitive strategies.

In addition to knowledge of the physical phenomena that make vision possible or not, it has been argued that children also need to have some understanding of the mental states of others – a theory of mind – in order to be able to take the perspective of another. However, there is disagreement as some psychologists (e.g. Gopnik et al., 1994) propose that an understanding of eye-direction (an important factor in predicting the visual experience of another) is a precursor to the understanding of mental states. In contrast, McGuigan and Doherty (2002) speculate that development

takes place in a reverse direction: that is, at around the third birthday or shortly before, children begin to understand false belief (Perner, Leekham, & Wimmer, 1987). Thus, it appears that at around three years of age children are beginning to be aware of mental states.

What someone has seen is a vital determiner of what they believe or know, and McGuigan and Doherty (2002) suggest that children are likely to become interested in eye direction, not only as one cue that indicates that people are engaged with them. Rather their interest in mental states may facilitate their appreciation of the critical nature of visual access and therefore they pay close attention to eye direction as a cue to it. This is not to say that children are *insensitive* to eye gaze before the age of three, and a number of examples of sensitivity to eye gaze in infancy and early childhood were reported above. However, sensitivity to is not the same as understanding of. Such findings do not provide evidence that young children understand that to see is to gain visual information, only that they understand implicitly that to see is associated with ‘giving attention to’, or ‘engagement with’ (McGuigan & Doherty, 2002). It is only at the age of three years that children are able to perform successfully on tasks that explore their understanding of vision in terms of informational access (McGuigan & Doherty, 2002).

4.3. Chapter Summary

This chapter has provided an overview of the literature to date relating to the development of perspective-taking ability in sighted children. In summary, if we accept Flavell’s levels of development theory, then we can say that sighted children gradually acquire a set of general rules about vision. In addition, through experience

and general cognitive development they also learn a number of relevant qualifications or limits on those rules. Flavell (2004) illustrates this with the following example:

... they [children] learn that people see things when their eyes are open (rule), but then need to learn that people do so only if their eyes are pointed in the right direction, if there is no intervening visual barrier, and if the things are not too small, too far away, too dimly lit or too camouflaged (qualifications). (p.30).

What then of blind children's development? Does their lack of visual experience prevent them from learning these rules and qualifications? Research findings that shed some light on this topic are considered in the next chapter.

CHAPTER FIVE

THE DEVELOPMENT OF PERSPECTIVE-TAKING IN BLIND CHILDREN

5.1. Introduction

It has been suggested that at Level 0 in the development of perspective-taking abilities, occurring between birth and around two years of age, sighted children are unable to represent or predict the visual experience of another person. They are however interested in and sensitive to the looking behaviours of others (e.g. Batki et al., 2000; Dunphy-Lelii & Wellman, 2004; Hood et al., 1998; Maurer & Salapatek, 1976; Woodward, 2003). During this period, they develop an increasing awareness of the relationship between the viewer and the viewed, which provides the foundations for the development of Level 1 perspective-taking skills. Because they cannot see, blind infants miss out on this important experience of the looking behaviours of other people. Thus, the four basic concepts that are essential to the development of Level 1 perspective-taking skills, *viz.* people see with their eyes; eyes see what they are oriented towards; obstacles block vision; and one person's view of an object is not necessarily another's (Lempers et al., 1977) may pose problems for children who are blind. This chapter takes a look at evidence of blind children's understanding of vision and their ability to take the visual perspective of a sighted person.

5.2. What do blind children understand about visual perception and perspective-taking?

Many studies provide evidence to suggest that congenitally blind children are delayed in their acquisition of visual perspective-taking abilities in comparison to their sighted

peers (Bigelow, 1988, 1991a, 1991b; Hatwell, 1984; Miletic, 1995; Millar, 1976; Nock et al., 2003a, 2003b; Nock, Lewis, Collis, Twiselton, & Burns, 2004). This delay is unsurprising, given that for congenitally blind children, understanding about the limits and capacities of vision are affected not only by general cognitive development, but by the necessity of grasping a set of rules relating to a modality to which they do not have access, and which they can only understand either through explanations about vision, or by analogy to the perceptual experiences they do have. Congenitally blind children, unlike their sighted peers, have no *direct* experience with vision to correct any misconceptions that they hold, and their performance on perspective-taking tasks could be adversely affected by such a knowledge-base deficiency. Thus, although young blind children, like their sighted peers, have been found to have an early awareness of visual perception, they have more difficulty understanding the conditions that govern the observer's ability to see objects (Bigelow, 1988, 1991a; Nock et al., 2003a, 2003b; Nock et al., 2004)

It has been suggested that understanding of the minds of others is a necessary prerequisite for perspective-taking ability (e.g. Gopnik et al., 1994). Several studies have suggested that blind children are delayed in developing a theory of mind (e.g. Green et al., 2004; McAlpine & Moore, 1995; Roch-Levecq, 2006) and this factor may contribute to their difficulty in taking the visual perspective of another person. However, it is not clear whether development of theory of mind facilitates perspective-taking ability or *vice versa*. A 'common sense' approach suggests that to predict what a person can see when at a different physical position from oneself requires the ability to comprehend that the experience of that person is different from

one's own. If this is the case, it seems likely that the former position is correct, namely, theory of mind facilitates perspective-taking.

On the other hand, it can be argued that in order to succeed on a false belief task which uses, for example, the changed location paradigm, a child needs at least Level 1 perspective-taking ability to appreciate that the protagonist has failed to see the object being moved from the initial hiding place to another one, based on straightforward knowledge of occlusion. On deceptive container tasks demanding Level 2 understanding (Gopnik et al., 1994), children need to ignore their own perceptual information, (for example that a Smarties tube is actually filled with pencils), and imagine the naïve viewer's assumption (e.g. the Smarties tube is filled with Smarties). Gopnik et al. (1994) proposed that Level 2 perspective-taking is a prerequisite skill that precedes and enables the appreciation of false belief. This, the authors claim, takes place through a process of 'bootstrapping' in which the concept of belief first emerges in the form of notions about what a person sees in their 'mind's eye'.

The hypothesis that perspective-taking ability is a precursor to theory of mind was explored by Peterson, Peterson and Webb (2000). They tested 23 children aged six, eight and 12 years, who were either totally congenitally blind or had severe visual impairments. They found that the six- and eight-year-olds experienced difficulties with both changed location and misleading container tasks, but had no problems with a Level 2 perspective-taking task. The researchers concluded that difficulties with theory of mind concepts could therefore not be attributed to the inability to take the perspective of another person.

If Peterson et al.'s (2000) findings are taken at face value, then there is no reason to suppose that any delay in the development of theory of mind in blind children should affect their ability to take the perspective of another person, and that in fact, the two skills develop separately.

The basic knowledge that sighted people see in a different way from their own 'seeing' (usually meaning perception through touch (Landau & Gleitman, 1985)) is present in some blind children as young as five years (Bigelow, 1988; Peterson et al., 2000). This suggests that some blind children, like their sighted peers, have by the end of their preschool years grasped a rudimentary understanding of perspective-taking. However, many studies suggest that Level 1 visual perspective-taking ability is not apparent in blind children until they reach six to seven years of age. A review of some empirical studies will provide evidence that blind children can and do acquire Level 1 visual perspective-taking skills, albeit later than their sighted peers.

5.2.1. Level 1 perspective-taking in blind children

Children's hiding skills are believed to be a sign of their ability to infer what is seen by another person (Flavell et al., 1978) and constitute Level 1 knowledge in Flavell et al.'s model. Bigelow (1991b) carried out a longitudinal study in which the hiding skills of two blind boys, aged six and seven years at the start of the study, two boys with residual vision aged five and six years at the start of the study, and nine typically developing children aged three to six years at the start of the study, were documented. The totally blind children were less successful than the children in the other two groups. Over a 12-month period, the children with some residual vision developed the ability to hide themselves or a toy completely, but the blind children made similar

errors to those of the youngest sighted children, often covering a toy or a part of their body with their hand, which frequently resulted in only a partial hiding. When asked to hide themselves completely, they often simply covered their face, especially the mouth, or curled into a ball and kept very still and quiet. At the completion of the study (when the blind boys were aged seven and nine years respectively), they were still unable to hide themselves completely, whereas the sighted children and children with residual vision typically moved to another room, or hid themselves totally behind furniture. This suggests that the blind children knew that sound or movement could expose them, but that they did not understand that simply covering a part of their body left them visually exposed. These behaviours also raise questions about how blind children interpret the personal pronoun 'you'. When asked, 'Can I see you?' young sighted children tend to locate 'self' in the facial region, particularly in the eyes (Flavell et al. 1980) and have a tendency to cover only their eyes when 'hiding'. The youngest sighted children (aged 3.33 to 4.05 years), and one of the children with residual vision (tested at aged 6.33 and 6.57 years) in Bigelow's (1991b) study behaved consistently with this. The child with residual vision persisted with these behaviours for longer than did his sighted peers. Interestingly, the blind children and the other child with residual vision responded as though the mouth was the area of self-exposure.

Studies such as this provide rich data and add to our understanding of development in the absence of vision. However, the methodology used by Bigelow (1991b) may be criticised in that the age-range of the two blind children was limited, and thus, despite the longitudinal nature of the studies, clear developmental trends cannot be identified. This said, the scarceness of congenitally blind children with no other impairments

makes recruitment of suitable participants a challenge for all researchers in this tradition. A further criticism is that the terminology used was problematic. The children were asked to hide a body part or an object and then were asked, 'Can I see your ...?', 'Can I see you?' or 'Can I see the toy?' depending on which was appropriate. Children could have interpreted this as a request rather than a question. The importance of care in selection of materials and use of language is an issue that will be returned to in Chapter Six.

Another method employed by Bigelow (1988) was to ask two blind brothers aged four and five years to show a sighted observer a portable object, a non-portable object and an object that could be worn. The boys demonstrated a clear understanding that sighted people, unlike their blind sibling, did not need to touch an object in order to 'see' it. The five-year-old oriented objects correctly for the observer to see them, but the younger child did not. This suggests that the five-year-old had some emerging ability in Level 1 perspective-taking. However, both children made several mistakes when showing the objects to the sighted observer: they overestimated the effects of distance, and moved the portable object from a distance of 3.6 metres to a distance of 1.5 metres, so that the observer could 'see' it; the younger child also failed to turn around when asked to show an object which was on his back, instead, pointing to the object, or guiding the observer's hands around to his back.

These studies and others like them (e.g. Bigelow, 1988; Bigelow, 1992; Fraiberg, 1977; Landau & Gleitman, 1985) have led researchers to conclude that Level 1 perspective-taking is not present in blind children until the age of at least six or seven years, and in the case of Farrenkopf and Davidson (1992), not until the age of nine to

ten years or even later. However, Bigelow's (1988; 1992) methods can again be criticised in that only two totally blind children participated and both had the same etiology. Furthermore, these children were siblings, so shared the same parents and lived in the same environment. This calls into question any generalisations from their performance to other totally blind children.

A number of other studies have reported very different findings. Peterson et al. (2000) found that 20 out of 23 visually impaired children aged between five and 13 years, (ten were totally blind, the remainder had some residual vision) performed at ceiling when asked to orient an object in a particular way for an observer sitting at a 90° angle to the child's right or left.

A congenitally totally blind child of 3;7 demonstrated that she had some understanding of the perspective of another person by turning around to an appropriate position when asked to show the seat of her pants (Landau & Gleitman, 1985). At the age of 4;8, the same child was able to state correctly that when behind a screen, her mother could not see an object that she herself was holding (Landau & Gleitman, 1985).

More recently, a single-case study carried out with a congenitally blind three-year-old (36 months exactly) added credibility to the possibility that Level 1 perspective-taking is present in blind children earlier than previous research has suggested (Brambling, 2005). The study is particularly interesting because the child spontaneously demonstrated this ability whilst carrying out another task. It was only while the researchers were viewing videotapes of her performance on this other task that they

noticed the behaviour. The child spontaneously removed her hands from a sweet that she was trying to unwrap, in order to enable the cameraman to see it. Brambling comments that many examples of perspective-taking ability may be embedded within naturally occurring events, and go un-noticed by researchers. Indeed, artificially produced experimental situations may be confusing and hard to grasp, thus impeding children's performance on some tasks.

Taken together, these studies show that although researchers disagree about the age at which it emerges, blind children develop Level 1 knowledge of visual perspective-taking, despite their lack of visual experience. There are areas of common difficulty though for blind children, even at Level 1. Although they can often successfully predict when vision is and is not possible for an observer, particular phenomena are problematic for blind children, and they do not always grasp the four basic concepts identified as essential to the development of Level 1 perspective-taking skills (Lempers et al., 1977) referred to at the beginning of this section. For example, in terms of understanding that obstacles block vision, four-year-old blind children may not understand that their own body can be an obstacle to vision, and seem to operate on an inaccurate rule in which proximity *always* equals vision (Bigelow, 1988). Nock et al. (2004) investigated this further and carried out a simple perspective-taking task with 11 congenitally blind children, aged between 4;4 and 11;4 (mean 7.8 years). The child held a soft toy close to his or her abdomen while the researcher moved to various locations mainly within the same room, some behind the child and some in front, at a distance of one and four metres. The child was asked whether he/she thought that the researcher was able to see the toy from the different positions. Five children aged from 4;4 to 11;4 did not understand the effect of their own body

intervening between the toy and the researcher at a one-metre distance, and believed that the researcher could see the toy even when she was positioned to the rear of the child.

In one trial the child and researcher were positioned around a corner from one another; the researcher went into a room adjacent to where the child was, left the door ajar, and stood close to the partitioning wall, at the other side of which stood the child. Both faced towards the partitioning wall, and the maximum distance between the two did not exceed two metres. The children aged six years and below (three in total) tended to say that the researcher could see the toy despite the corner. The authors concluded that blind children aged six years and below experience difficulty understanding the effect of corners upon vision.

In relation to the concept of eyes seeing what they are oriented towards, the blind children of six years and younger had difficulty with the tasks in which the researcher was at a distance of one metre from the child and toy, but facing away from them, and tended to say that the toy was visible to the researcher even though she was oriented in the wrong direction. Nock et al. (2004) concluded that blind children of six years and below may not understand that eye gaze must be directed towards the object if it is to be seen.

It seems then that the flawed rule that proximity always equals vision is used by young blind children to make decisions about whether or not an object is visible to an observer. This rule appears to 'short-circuit' or override any knowledge that they may

have about the effects of eye-gaze and intervening obstacles such as their own bodies or 90° corners when carrying out perspective-taking tasks.

Having established that despite their lack of personal visual experience, blind children develop Level 1 knowledge of perspective-taking (although researchers disagree about the age at which understanding emerges), the focus now turns to the development of Level 2 understanding, in which children understand that not only can people see objects, but also that they have differing visual experiences of the same object when viewing it from different positions.

5.2.2. Level 2 perspective-taking in blind children

Arguably, comments made by blind children suggest that although they are able to take the perspective of another and make correct predictions about visibility, their understanding of *how* things look is often limited and inaccurate (Bigelow, 1991b; Nock et al., 2003a, 2003b). They seem not to understand whether vision is clear or indistinct, for example objects seen in poor light or at great distance or in peripheral vision. Also, they experience some difficulty predicting whether an object is fully or partially visible. The following examples illustrate some of the problems experienced by blind children in Level 2 perspective-taking tasks.

When asked whether a sighted person could see a small teddy bear through an 80mm. wire mesh screen, nine of the 12 congenitally blind children (age-range 5;3 to 12;5) studied by Nock et al. (2003b) made a number of common errors. Although most said correctly that the bear could be seen, they frequently added that the colour of the toy was not visible, or that it could be seen but that it could not be identified as a bear, or

its furriness or facial features could not be seen. These errors were observed across the entire age-range.

In the same study, a six-year-old blind girl when asked if the toy bear was visible through the wire mesh screen, responded 'You can't see it, 'cos it's keeping very, very still', indicating that she did not understand how movement affects vision. It is possible that she was making an analogy to hearing, and that by "still" she meant "quiet" rather than "not moving".

There is also evidence that blind children overestimate the effect of angle upon vision. For example, Nock et al. (2003a), reported that a blind child aged 9;7, standing at the bottom of a slight incline, believed that he could not be seen clearly by a sighted observer at a distance of approximately 12 metres, standing at the top of the incline. When asked why he could not be seen, he replied, "She can only see my head because it's higher, but not my body, it's too low". Blind children's overestimation of the effect of angle has also been documented by Nock et al. (2003b) and Bigelow (1991a).

Some blind children of eight years and over are familiar with the rule that light has an effect on visual perception (Nock et al., 2003a, 2003b), and use this rule in visual perspective-taking tasks. However, they tend to over-emphasise this effect. Nock et al. (2003a) reported that two blind children aged eight and nine years stated that the shadows between themselves and the observer, who was 15 metres away, would prevent the observer from seeing them. The nine-year-old said 'There's a black shadow in between me and him blocking his vision'. Blind children's confusion about

the effects of distance on vision has been well documented in a number of studies (e.g. Bigelow, 1988, 1991a; Nock et al., 2003a, 2003b; Nock et al., 2004). Typically, they over-estimate the effects on vision of distance. When Bigelow (1988) asked two congenitally blind brothers aged four and five years to show objects to an observer who was positioned four metres away, the children maintained that the observer was too far away to see the objects and brought them to a distance of one and a half metres or less in order to allow the observer to see the objects. Similar findings have been reported by Bigelow (1991a), Nock et al. (2003a; 2003b) and Nock et al. (2004). These will be discussed in the next section.

These examples illustrate the difficulties that blind children experience when attempting to take the perspective of another person, particularly in Level 2 terms. As noted previously, perspective-taking in sighted children is affected not only by general social and cognitive development, but by the assimilation of their own experiences of vision into their knowledge base, updating and correcting any misconceptions in order to become more expert in their perspective-taking abilities. For blind children, the ability to predict what another person sees, and how it appears to them, is far more complex. The absence of visual experience makes it very difficult for blind children to assimilate what effects, if any, factors such as occlusion, distance and relative position may have upon the observer's ability to see objects, and how the views of those objects appear. Their understanding of vision, and the ability to take the visual perspective of another person is affected not only by general cognitive development, but by the ability to grasp rules and conditions of vision, which they cannot access, and can only understand either through explanations about

vision, or by analogy to their own perceptual experiences. It is to the use of analogy by blind children in visual perspective-taking tasks that the discussion will now turn.

5.2.3. Blind children's use of analogy in visual perspective-taking tasks

The findings of a number of studies, which will be discussed below, give rise to the possibility that some of the errors that are commonly seen in blind children's perspective-taking are possibly based on flawed analogies to their own perceptual experiences. For example, if they try to understand vision through their experience of auditory information, they may think that vision travels around corners, because sound does. Similarly, tactile information can only be gained when in close proximity to an object, but vision is possible from a distant point, so again, the use of analogy might cause confusion.

Blind children's spontaneous use of analogy from touch to vision over both short and longer distances was explored by Nock et al. (2003a; 2003b). Twelve congenitally blind children aged between five and 12 years took part in both studies. In the first study (Nock et al. 2003b) four mesh screens with different sized apertures (80mm; 25mm; 5mm and 1mm) were placed in counterbalanced order, starting with the largest apertures, in the front of a wooden box (380mm by 380mm by 380mm), in which the child had placed a small teddy bear. The child was allowed to explore the meshes tactually, and to put his/her hands/fingers through the apertures where possible. Once the child had placed the screen in the front of the box, the sighted experimenter asked: 'Can I see the bear?' This procedure was carried out with the toy at the very back of the box, and then at the front of the box. The toy was visible to the experimenter in all the trials.

The experimenters predicted that if blind children do indeed over-generalise from their tactual experiences, they should expect that an 80mm. mesh can be seen through (because they can get their hands through to touch the toy), whereas a 1mm. mesh cannot (because they cannot feel the toy through the holes). It was less easy to predict responses with the intermediate sizes. In terms of right and wrong answers, with the data pooled across all eight trials, there was a clear linear positive correlation with age. Generally, all but the youngest children performed near ceiling in the trials with medium and large mesh sizes, but there was rather more variation among the children in performance on the trials with fine and small mesh sizes. With the exception of one child, the children concluded that if they could touch the bear, then the experimenter could see it, suggesting that they may have based their responses upon tactual rules. Interestingly, most (75%) of the children believed that details of the bear, (e.g. nose, ears), could not be seen, even through the largest mesh. Again, this suggests that in the context of this study, touch was being used to infer visual information: if there is an object, however small, between the skin and the object to be felt, then the intervening object will prevent full sensory experience of the object. Parts of the object would be 'blocked out'. It is possible, although by no means certain, that the children applied a tactual rule to make predictions about vision.

Having explored the possible use of analogy to touch over short distances and found that congenitally blind children may tend to use touch to predict the visual experiences of sighted people in some contexts, Nock et al. (2003a) investigated the same phenomenon over much longer distances. Each child was taken to two familiar outdoor landmarks with two experimenters. The landmarks were as far apart as possible, up to a distance of 26 metres. The child and one of the experimenters walked

from one location to the other in a straight line, and the child was asked, 'Can [other adult's name] still see us?' A second trial then took place, using two different landmarks, and in order to explore whether the children were making use of inaccurate analogies to their tactual experiences, tactile contact was maintained between the child and the stationary adult on this trial, by the use of a 30-metre tape measure, one end of which was held by the child and the other by the adult. The same procedure was then repeated, using four indoor landmarks. The children made very little reference to the tactile contact – a total of seven references only, but on three occasions, children believed that they could be seen when tactile contact was maintained, but not when it was not, so the experimenters concluded that for *some* blind children, information about their own experiences of touch were being used when making predictions about visual perception.

These studies address the use of analogy to the tactual modality, but there is a lack of direct exploration of analogies to the auditory modality, and most references to these phenomena are anecdotal. For example, a ten-year-old blind child stated that he could be seen by a distant sighted observer because it was windy. When asked why this was so, he replied, 'The wind will carry his vision' – a direct analogy to audition (Nock et al., 2003a). Clearly, more research is needed to examine how blind children use analogies to their intact modalities in order to understand how information is gained through the visual modality.

Apart from experiential knowledge of their four functioning sensory modalities, what other knowledge informs blind children's ability to take the visual perspective of a

sighted person? In the next section, blind children's reasoning on visual perspective-taking tasks will be considered.

5.2.4. Blind children's reasoning on visual perspective-taking tasks

When trying to determine how the blind children reached their conclusions in the studies discussed in the previous section, Nock and her colleagues (2003a; 2003b) looked beyond the children's correct or incorrect responses and explored the reasoning that they had used in order to make their predictions. From comments made it was clear that the children had used whatever information was available to them to construct a knowledge-base about vision. They frequently referred to what they had been taught about vision in science lessons at school and mentioned light, dark and shadow, opaqueness and transparency, and learning about how the eye works. They cited explanations and descriptions from sighted people as a source of their knowledge, and also inferences made from incidental conversations. As described in the previous section, they often appeared to make analogies to their own intact sensory modalities. Finally spatial information about distance: 'He's near enough to see me'; angle: 'We've gone in a straight line'; or occluding objects: 'There's nothing in between me and him', was often used. Nock et al. (2003a; 2003b) concluded that blind children show a remarkable grasp of how sighted people experience information gained from a modality to which the children themselves do not have access.

A phenomenon that was most notably reported by Landau and Gleitman (1985) is blind children's fluent use of visual terms. Kevin Carey (2002), who is blind, has coined the term 'literacy of vision' to describe proficient use and comprehension of the language of vision. This includes the use of visual terms in their concrete

meaning, for example, *shadow*, *dark*, *look*, *shiny* etc., and in cultural or figurative terms, such as *green with envy*. In the following three sections, evidence for the use of concrete visual terms by children who are blind will be explored, as the appropriate use of such language gives further insight into their understanding of vision.

5.2.5. Blind children's use of visual terms to refer to other sensory ways of perceiving

A number of studies (e.g. Landau & Gleitman, 1985) have explored the ways in which blind children use verbs of visual perception, such as 'look'. This is an active verb, and implies intentionality, referring to using the eyes to get visual information about an object or landscape etc., whereas 'see' is different, and does not contain the same implication of purposefulness, and can describe a factual state (Mehler & Dupoux, 1994). These differences are very subtle, and yet blind children often begin to use these words appropriately at a very young age, seemingly experiencing no more trouble with them than do sighted children (Brown & Bellugi, 1964; Landau & Gleitman, 1985). However, they may have a different understanding of the terms than do sighted children, using them in a way that describes their own perceptual experiences, nuancing them appropriately from the visual to the tactile modality. This explains why, when asked to look up, a blind child of three years reached her arms above her head, whilst blindfolded sighted children tipped their heads back, orienting their faces upwards (Landau & Gleitman, 1985). Blind children interpret the word 'look' as examine or explore, just as sighted children do. The difference is that for blind children, touch is the primary modality for exploration and information gathering, and the verb is shifted appropriately to that modality. Interestingly, blind children have also been observed interpreting the word 'see' as if it meant 'hear'

(Mills, 1988). Mills also notes that the use of visual verbs may be context dependent, or indeed used according to the child's individual preference for a particular modality. Blind children do not however confuse touch or hearing with vision, and understand that sighted people see things differently from the way that they do (Brambling, 2005; Landau & Gleitman, 1985).

A blind four-and-a-half-year-old provided an example of a blind child's use of vision words to describe her own perceptual experience when she said that she did not want to go into the coal shed because it was dark in there. When asked what she meant by 'dark' she replied 'Sort of still. And cold. Like when it's raining' (Urwin, 1981). As Lewis (2003) remarks, this understanding of darkness is as rich as that of a sighted person, and the child's understanding and use of the word is based on her own experiences through an alternative modality.

It is apparent then, from the examples given above, that blind children acquire and use visual terms to communicate and describe their own sensory, non-visual experiences. Is there any evidence though, of blind children using the language of vision to describe visual concepts and the concrete visual experiences of sighted people? The next section presents some examples of blind children's ability to do this.

5.2.6. Blind children's use of visual terms to describe and discuss actual visual concepts

Blind children are able to use visual terms to describe actual visual concepts and the visual experiences of sighted people. In two studies exploring blind children's use of analogy from touch to vision (Nock et al., 2003a, 2003b) reported in Section 5.2.3.,

blind children aged between five and 12 years demonstrated that they could use visual terms in appropriate ways. In one study the children were asked to predict whether the researcher could see a small teddy bear through various wire mesh screens. Although the children were not always correct in their responses, they spontaneously used vision-related words to explain the reasons for their answers. There were seven references to light, or lack of it. For example, an 11-year-old boy said that the toy couldn't be seen when it was at the back the box because it was 'in the shadow'. Four children aged between seven and 11 years referred to the field or range of vision. A ten-year-old boy said, 'You can probably see it because it's right in front of you ... in the field of vision'. There were eight references to blocked vision, for example, 'The wire's blocking it so you can't see it now' (six-year-old) and the children frequently used terms such as 'blurred': 'You'll see it but it's gonna look blurry, you won't see it properly' (five-year-old); 'unclear': 'I think that if you can see it you won't tell it's a teddy. It's just gonna look unclear to your eyes' (seven-year-old); or 'dim': 'Light won't be in the box so you won't see it. It's too dim' (ten-year-old) (Nock et al., 2003b).

Similar examples were found in the later study reported in Section 5.2.3. investigating blind children's use of analogies to the tactual modality over much larger distances. Twelve congenitally blind children aged from five to 12 years took part in the study, and again references were made to visual concepts, as the children attempted to rationalise why they believed that vision was possible or not. Several children, across the age-range said they could be seen 'because he's looking at me' or 'because we're near enough to be seen'. One boy aged eight years said he could not be seen because of 'a black shadow in between me and him blocking his vision'.

References were also made to angle: 'We've gone in a straight line and that means his sight will get to me' (eight-year-old) and lack of occluding obstacles: 'There's nothing in-between me and him so I must be visible' (four-year-old) (Nock et al., 2003a).

These examples illustrate the ability of blind children to use terms related to vision appropriately, although not always accurately predicting the effects of light, shadow, distance and angle etc. There are, though, some visually related words that blind children find particularly hard to grasp and a frequently given example is the use of colour words and terms. They may understand colours through association with their own experiences, for example that red is 'warm', perhaps through the knowledge that flames are red and hot, but can they ever fully appreciate what colours such as blue, red and yellow actually are? The following section will explore this question.

5.2.7. Blind children's use of colour terms

Blind and sighted children use colour words in their language, but before the age of three to four years, sighted children use the terms randomly (Mehler & Dupoux, 1994). At around four years of age sighted children begin to demonstrate the ability to use colour terms accurately and consistently. At the same stage, blind children cease to use colour words descriptively. A blind four-year-old (Kelli), who had previously used terms such as 'Here's the green one' when responding to a request for a green object, instead asked for help with selecting an object of a particular colour, knowing she was unable to do this without help from a sighted person (Landau & Gleitman, 1985).

Mehler and Dupoux (1994) concluded that these facts suggest that colour words are used superficially by all young children, whether or not they are blind. However, as sighted children become competent in their use of colour terms, blind children begin to recognise that they have problems in determining what these words, used randomly until this stage, actually mean. Despite the obvious problems associated with blindness and colour perception, blind children can differentiate between colour and non-colour adjectives. At the age of five years Kelli knew which familiar adjectives were colour terms e.g. black, green, yellow, red and blue, and which were not: e.g. round, square, big, soft, sweet, loud, soft, nice and pointy (Landau & Gleitman, 1985).

This issue was taken up by Carey (2002), who argued the case for explicit teaching about visual concepts, in particular colour, to congenitally blind children. He disagrees with those who question the relevance or even appropriateness of teaching blind children about colour and argues that congenitally blind children need every opportunity to ‘grasp [the] essentials of their environment.’ He acknowledges that blind children will never fully comprehend what the experience of colour is actually like, but claims that through the use of ‘special means’ (which, unfortunately, he does not specify), they can be helped to grasp the essence of visual concepts, including colour.

What then are these ‘special means’ that Carey urges sighted people to use in order to support blind children in their acquisition and use of visual terms? There is very little literature to draw upon in order to answer this question, and more research is needed in this area.

The development of sighted and blind children's understanding of vision and the ability to take the perspective of another has been documented in this and the previous chapter. There is some evidence (e.g. Bigelow, 1991a; Nock et al., 2003a; Nock et al., 2003b; Nock et al., 2004) to suggest that despite the differences in perceptual experience, the development of visual perspective-taking is similar in sighted and blind children, although the route they take to mature understanding is of necessity qualitatively different, given that blind children have no access to the visual modality. These similarities will be considered in the next section.

5.3. Similarities in the development of visual perspective-taking in blind and sighted children

Although sighted children tend to perform more successfully on visual perspective-taking tasks than do their blind peers, there is some indication from the errors that both groups make on visual perspective-taking tasks that they develop in a similar way. The following errors have been observed in blind children and also at times in younger, sighted children. First, sighted children below the age of five years do not understand that lines of sight must always be straight (Boydell et al., 2003; Flavell et al., 1991) and the responses from the blind children aged 11 years and below in Nock et al.'s (2004) study also suggested lack of understanding of the relationship between direction and vision.

Second, almost half of the blind children (age-range six to 11 years) in Nock et al. (2003b) experienced difficulties in appreciating principles relating to colour perception, and believed that although the toy could be seen through the mesh its colour could not. There was also confusion about whether the texture would be

visible. It is possible that although blind children may realise that a sighted person does not need to touch objects in order to see them, they may be unaware of the ways in which tactile perception and visual perception differ. However, as discussed in Chapter Two, sighted three- and four-year-olds also experience difficulties deciding whether vision can provide information about visual properties such as colour, or tactile properties such as texture or weight, suggesting that they have only a very limited understanding of the modality-specific nature of knowledge.

Third, Bigelow (1991a) found that sighted children aged between three and six years, when blindfolded, tended to make angle-related errors about whether an object could or could not be seen by another person, as did the blind children in Nock et al's (2003a; 2003b) studies.

It should not be assumed then that congenitally blind children's errors on visual perspective-taking tasks are simply a product of their blindness, as evidence suggests that their sighted peers share some of their erroneous beliefs. Blind children may persist in their mistaken ideas for longer periods than do sighted children because they do not have direct access to visual information, which could offer contradictory information to correct flaws and misconceptions. More exploratory work with sighted children needs to be carried out in this area, because notwithstanding blind children's difficulties, there is a danger that errors in blind children may be attributed to lack of vision, when in actuality, sighted children experience similar misunderstandings.

5.4. Chapter Summary

This chapter has provided an overview of the literature to date relating to the development of perspective-taking ability in blind children. It was argued that, despite their lack of visual experience, blind children can and do have some understanding of the phenomena that affect vision, and acquire both Levels 1 and 2 perspective-taking ability. This usually occurs at a later age than in sighted children and may, at times, be flawed. However, there is some evidence for Level 1 perspective-taking in blind children of three and four years (e.g. Brambring, 2005; Landau & Gleitman, 1985). Level 2 perspective-taking presents a particularly difficult challenge for blind children, as they strive to understand the rules and conditions for a modality to which they do not have access.

Despite these problems blind children use whatever information is available to them when trying to understand how sighted people experience vision. It is possible that they make analogies to their own functioning sensory modalities, explanations and descriptions from sighted people, scientific, spatial and social information, and inferences from incidental conversation.

The discussion then turned to the use of concrete visual terms by children who are blind, and evidence from empirical studies was reported to demonstrate that many blind children can and do use vision related language spontaneously. They use the verbs 'look' and 'see' in various tenses and forms, adjectives such as 'dim' and 'dark', and nouns such as 'shadow' and 'vision', to describe both their own perceptual experiences and the visual experiences of sighted people. From the available

literature, it seems that for blind children, the most problematic type of vision related language is the use of colour words.

Chapter Five drew attention to a number of important issues. First, there is a lack of research with sighted children about the development of explicit knowledge about the conditions under which vision is blurred or indistinct. Some examples were used to illustrate how blind and sighted children make similar errors on visual perspective-taking tasks, and it was argued that there is a danger of attributing blind children's mistakes to a lack of vision when sighted children do, in fact, make comparable errors albeit often when they are younger. Future research in this area would be useful in terms of clarifying similarities and differences in the development of blind and sighted children's perspective-taking ability, particularly at Level 2.

Second, blind children may use analogies to their intact modalities, particularly the auditory and tactual modalities, to try to understand vision. Some studies have explored analogies to touch (e.g. Nock et al., 2003a, 2003b) but there is a lack of direct exploration of analogies to the auditory modality, and most references to this are anecdotal.

Third, previous studies have identified misconceptions in blind and sighted children's understanding about vision, but most have not asked children *why* they believe what they do. Information about the factors that inform blind and sighted children's understanding of vision would help to identify similarities and differences in the development of the understanding and ability of both groups.

Fourth, some of the methods used in the studies described were argued to have limitations, and the hiding studies (Bigelow, 1988, 1991b, 1992) in particular might have produced different results had less artificial procedures been used. On a related theme, much of the research to date has been shaped by adult understanding of the factors that affect vision, without consideration of the beliefs and opinions of children about what factors facilitate or inhibit vision. Furthermore, the approach taken has been largely quantitative in nature. There is a need for studies using more robust methodology to appreciate better what blind and sighted children understand about the factors that affect the visual experience of sighted people.

Some of these issues will be addressed by the empirical studies reported in this thesis. Chapter Eight will explore congenitally blind and sighted children's understanding about three important factors that affect vision, *viz.* distance, occlusion, and orientation of both the viewer and the viewed, and will also aim to identify blind children's possible use of analogies to other sensory modalities when making predictions about the visual experience of another person. Chapters Nine and Ten will compare the opinions of blind and sighted children about the phenomena that affect vision, and Chapter Eleven will investigate blind children's ability to hide successfully in a game of hide-and-seek in a ready-made scenario in which a variety of hiding places are available. The final empirical study, reported in Chapter Twelve, will report the views of parents and teachers of congenitally blind children about how blind children demonstrate an understanding of vision through their language and behaviour.

CHAPTER SIX

METHODOLOGY

6.1. Introduction

This chapter identifies key issues related to methodology that are pertinent to this thesis: methodological considerations when carrying out research with children who have impairments, particularly when that impairment is congenital blindness; and methodological considerations when interviewing adult participants. The recruitment of participants who took part in the empirical studies is described and details about the participants are reported.

6.2. Methodological considerations

6.2.1. Methodological considerations when carrying out research with children with impairments

The aim of this section is to identify specific methodological considerations when doing research with young children, and to note where particular problems may arise when doing research with children who are blind. Some examples will be given from other studies to illustrate how problems can arise, and what steps can be taken to minimise the likelihood of such difficulties occurring.

6.2.1.1. Under- or over-estimation of ability

There are a number of potential issues that researchers need to take into consideration when exploring development in children with impairments. First, the under- or over-estimation of ability can have a deleterious effect on our understanding of impairment and its effects on development. As Urwin (1983) points out, if development in such

children is underestimated, it is possible that the role of disability in development may be overestimated. If researchers ignore this caveat, deficit models of development are likely to emerge from research with children with impairments.

Over-estimation of ability is equally misleading. Lewis and Collis (2005) provide an interesting account of how this phenomenon has been observed in the case of the drawing abilities of children and young people with autism. Whilst they concur that some children and young people with autism are able to produce very accurate drawings that clearly reflect what they actually see when they look at an object, person or view, they argue that positive findings such as these may result in a bias toward focusing on the few individuals who possess such exceptional abilities rather than the majority of children and young people with autism who do not.

One way of reducing the possibility of drawing erroneous conclusions about the development of children with impairments is to ascertain that appropriate research methods are employed. The next section focuses on this topic.

6.2.1.2. Relevant and meaningful materials and concepts

One methodological issue central to a study involving both blind and sighted children is the development of methods that blind children can access as fully as sighted children. This presents a challenge to sighted researchers, who may make assumptions about the relevance for blind children of materials and concepts that are familiar to sighted people. For example, in a study exploring theory of mind in blind children (Minter et al., 1998) blind and sighted children aged between five and nine years were asked to feel a warm teapot and say what they thought was inside it. Most responded

that it was tea, but when the contents were revealed, it was actually warm sand. They were then asked what they thought was in the teapot before the contents were revealed, and also, what a friend would think was in the pot if they felt at it. For their own stated original belief (tea), 42 per cent of the blind children gave incorrect responses, claiming that they had thought that the teapot contained sand. Fifty-three per cent of the blind children said that a friend would think sand, rather than tea, was in the pot. Fewer than ten per cent of the sighted children responded incorrectly. These findings led Minter et al. (1998) to conclude that in comparison to sighted children blind children are delayed in developing a theory of mind.

Questions regarding Minter et al.'s (1998) conclusions have been raised, for example by Lewis (2003) and Peterson et al. (2000). They argue that totally blind children may have experienced teapots only through the *aroma* of hot tea, and not through tactile exploration. They are very unlikely to have felt at the spout, handle or lid of a warm teapot containing tea, because of the strong possibility of scalding, breakage or spillage. Thus, it is possible that the blind children in Minter et al.'s (1998) study may have had no foundation upon which to make a prediction about what an uninformed person would think that an odourless teapot would contain.

Peterson et al. (2000) emphasised that the use of such inappropriate materials may impede blind children's performance in some tasks, and suggest that failure on the teapot task does not of necessity reflect an immature theory of mind. Further, they added that Minter et al. (1998) based their conclusions almost entirely on the poor performance of the blind children in the misleading appearance task (i.e. teapot), even though the same blind children performed very well (80% correct) in a changed

location test corresponding to the familiar Sally-Ann paradigm (Baron-Cohen et al., 1985), in which the participant is required to infer search behaviour resulting from false belief. It is possible then, suggest Peterson et al. (2000), that misleading container tasks present particular problems to blind children because tasks of this nature demand more sophisticated visual perspective-taking abilities than do changed location tasks (see also McAlpine & Moore, 1995 for similar findings).

Peterson et al. (2000) administered a battery of four false belief tasks involving misleading appearances and changed locations, and a Level 2 visual perspective-taking task in their research with 23 five- to 12-year-olds with a range of visual impairments, including ten who were totally blind. They found that blindness *per se* did not affect success on theory of mind tasks, but that age did. Throughout, the researchers used familiar paradigms, but adapted and piloted them extensively in order to ensure that the materials would be accessible, understandable and relevant to their blind participants. For example, one misleading container task was modelled on the Smarties task (Perner et al., 1987), but the researchers wanted to find a container that would 'evoke belief in a unique type of contents in blind children' (Peterson et al., 2000, p. 437). They finally chose a cardboard egg carton, which is completely enclosed and is a distinctively shaped familiar household item.

The second misleading container task employed a milk carton task (McAlpine & Moore, 1995), but again, with two modifications. First, the naïve other (whose beliefs about the contents of the misleading container were to be inferred) was a peer with equal or lower visual acuity. This adjustment was particularly astute, allowing for the belief of many young children in the omniscience of adults (Peterson & Siegal, 1998),

even when they appreciate false belief in relation to themselves or other children, and which may be particularly manifest in children with sensory impairments, such as blindness or deafness.

The second adjustment involved replacing the contents of the milk carton with water in a different room from the naïve other, eliminating the possibility of being overheard, in contrast to McAlpine and Moore (1995) whose procedure involved substituting the expected contents of the milk carton in whispers whilst in the same room as the naïve other.

In a similar vein, Lewis, Collis, Nock, Twiselton & Burns (2004) demonstrated that with relevant and meaningful tasks, often incorporating a non-verbal response format, blind children were able to demonstrate an understanding of medium scale space in Euclidean terms at a much younger age than reported in two studies that were published in the 1990s (Bigelow, 1991c, 1996). Bigelow concluded from her studies that until their teens, blind children have only a route-based understanding of the relationship between different parts of their homes, while sighted and partially sighted children, from five to six years, understand straight line (Euclidean) directions between rooms. However, the tasks she used were described by Lewis and her colleagues (Lewis, Collis, Shadlock, Potts, & Norgate, 2002; Lewis et al., 2004) as methodologically unsound. One of their criticisms was that the tasks used by Bigelow (1991, 1996) were inappropriate for children who are blind. For example, one of the tasks required that the children point at named rooms in their own homes, whilst another involved the identification of the shortest of three 'magic ropes' which went in straight lines, passing through ceilings, walls and floors, from one location in the

child's home to three different locations around the house or surroundings. Lewis et al. argued that many blind children do not use pointing as a gesture, and that they may have interpreted instructions to point at a named room differently from sighted children or children with a small amount of vision. The magic rope task is particularly complex, exerting excessive cognitive demands on both blind and sighted children, requiring as it does that they first imagine ropes which can go in straight lines through solid structures, and then, compare their imagined lengths.

Attentive to the problems with Bigelow's tasks, Lewis et al. designed and administered a number of new and more appropriate tasks, in which blind and sighted children were asked, for example, to orient a teddy so that teddy 'looked towards' different rooms in the house, or to name rooms when a model of the house was built by the child and the researcher using large, plastic blocks. Lewis et al. (2004) reported that several blind children in their study demonstrated an understanding of space in Euclidean terms at much younger ages than reported by Bigelow (1991, 1996).

It is evident then, that a large body of research with congenitally blind children has produced negative findings, and this may be due partly to the use of inappropriate research methods. Many of the findings have been challenged by researchers using more appropriate research methods, which Lewis and Collis (2005) call 'methods fit for purpose'.

Of course, meaningful and relevant concepts and materials are important in all research, not only that which investigates children with disabilities, and it is helpful to recall, at this point, Donaldson's (1978) criticisms of Piaget and Inhelder's (1956)

three mountains task (see Section 4.2.), specifically that it was a particularly artificial task for young children, and not likely draw out their knowledge and ability. Borke (1971) commented that the task was not motivating or interesting, and the materials used were unfamiliar. Borke (1971) and Donaldson (1978) both were able to demonstrate that when children are engaged with tasks that make human sense, their performance is improved.

Mindful of the pitfalls of using inappropriate materials and situations, care was taken throughout the design and implementation of all the empirical studies reported in this thesis to ensure that the tasks were appropriate for blind children, using materials and language with which they were familiar, and procedures that they were able to perform. Tasks and materials were piloted in order to ensure that they were accessible, understandable and relevant to the participants. Although it was not always possible to pilot the tasks on blind children (because of the size of the sample) care and consideration were applied throughout.

A related issue is that of response formats. The next section looks at alternatives to verbal responses, which may place young children at a disadvantage if they have limited linguistic ability, which is to be expected in young children, or if they have implicit knowledge which is not explicit or procedural.

6.2.1.3. Non-verbal response formats

Building in non-verbal response formats wherever possible has been demonstrated to facilitate the performance of young children in a number of studies, as this increases the likelihood of children's ability to demonstrate knowledge that they are unable to

articulate. For example O'Neill and Chong (2001) demonstrated that a non-verbal response format greatly facilitated performance in sighted children of four years of age (see Section 2.4.) on tasks exploring understanding of the aspectuality of knowledge. Similarly, Lewis et al. (2002; 2004) were able to elicit increased success on spatial tasks by blind children than had been previously reported, through the employment of non-verbal responses as described in Section 6.2.2.

Furthermore, educational research indicates that incorporation of kinaesthetic activities (e.g. movement; manipulation of objects and materials etc.) are likely to engage children more fully in tasks and make them more enjoyable (e.g. Briggs, 2004; Clark, 2003). Where children are given an option to respond verbally or kinaesthetically to a task, they often choose the latter mode. For example, in a study exploring how blind children develop an understanding of familiar medium-scale space, the children were asked to operate a bell or a hooter to indicate whether pre-recorded utterances related to their own homes or elsewhere (Collis, Lewis, Nock, Twiselton, & Burns, 2004). In the same study, again in response to pre-recorded utterances, the children had to decide whether big movements or small movements were being talked about, and were asked to respond with gestures; either arms stretched out sideways so their hands were as far apart as possible (for big movements), or hands just a few centimetres apart (for small movements). Although a few of the children preferred to respond verbally, they generally chose the kinaesthetic response.

With due recognition of these issues, non-verbal, kinaesthetic response formats were included in the design of the empirical studies reported in Chapters Seven to Eleven,

wherever appropriate, in order to facilitate children's ability to demonstrate their knowledge even if they were unable to express it verbally, and to increase engagement with, and enjoyment of, the research tasks.

6.2.1.4. Caution in interpreting findings

It was noted in Section 5.3. that caution should be applied in interpreting conclusions about the effects of congenital blindness on the development of understanding about vision. Some misunderstandings observed in blind children may also be present in sighted children. For example, sighted three-year-olds do not appreciate that lines of sight must *always* be straight (Boydell et al., 2003; Flavell et al., 1991), and sighted four-year-olds do not fully understand the limits of what can be discovered through vision (O'Neill & Chong, 2001; O'Neill & Gopnik, 1991). It would be wrong to conclude then that blind children's misunderstandings of visual rules are simply a product of their blindness, given that sighted children hold similar beliefs. It would be more accurate to suggest that blind and sighted children hold some similar erroneous beliefs about visual rules, but because sighted children have direct access to visual information, their misunderstandings can be corrected at an earlier stage than is possible for blind children, as their experience of and attention to visual phenomena increase.

It is important then, for researchers to study early development of understanding about vision in sighted children in order to identify the prevalence of similar mistaken ideas about vision in both populations. In the course of the current research, blind and sighted three-year-olds were included wherever possible. Also, in addition to the tasks that were administered, and bearing in mind what has already been said about the

limits of young children to make verbal responses, children were asked to explain *why* they believed what they did, whenever it was appropriate, in order to gain information about the factors that inform children's understanding of vision.

6.2.1.5. Considering the opinions of children

It was argued in Chapter Five that much of the research methodology to date has been constructed by drawing upon adult understanding of the factors that affect vision, with little or no reference to the beliefs and opinions of children. The empirical studies reported in Chapters Nine and Ten aimed to address this lacuna by first soliciting children's own opinions about vision, and then incorporating and building upon these opinions to design and produce two research tasks, which compared the opinions of blind and sighted children.

6.2.1.6. The combined use of quantitative and qualitative methods

Finally, the approach to research in this area could broadly be classed as quantitative in nature. The studies reported in this thesis used a combination of both quantitative and qualitative approaches wherever possible and appropriate. This combination of both types of methodology is discussed at length by Punch (1998):

... the quantitative approach conceptualizes reality in terms of variables and relationships between them... It does not see context as central, typically stripping data from their context... Quantitative data enable standardized, objective comparisons to be made, and the measurements of quantitative research permit overall descriptions of situations or phenomena in a systematic and comparable way... Qualitative methods are flexible [and] accommodate the local groundedness of the things they study – specific cases grounded in their context. Qualitative methods are the best way we have of getting the insider's perspective,

the 'actor's definition of the situation', the meanings people attach to things and events. (pp. 242-3).

For the purposes of this thesis, there was a need for both types of approach. Quantitative methods allowed for objective comparisons to be made where appropriate, and on the other hand, qualitative methods placed the data back in context, fleshing out the statistics in such a way that the richness of the data could emerge. Thus, it was hoped that the employment of qualitative methods would complement and enrich the quantitative data.

6.2.2. Methodological considerations when interviewing adult participants

The final empirical study reported in this thesis elicits the views of parents and educators of congenitally blind children through the use of a semi-structured interview. Collecting and analysing interview data can be time-consuming, and many researchers opt for the quicker option of questionnaires. Also, there is a danger of researcher bias, subjectivism and a temptation to prove a general case from single instances in the use of interviews (Breakwell, 1995). However, interview research has the advantage over the use of questionnaires in that it allows the researcher "...to follow up ideas, probe responses and investigate motives and feelings which the questionnaire can never do." (Bell, 2001, p. 135). One of the inherent weaknesses of interviews, however, is the problem of participant and researcher reactivity, which can affect the reliability and validity of the data (Punch, 1998). What informants wish to tell the researcher will, for instance, depend upon how they wish to present themselves to the interviewer and they may tailor their responses in order to provide the interviewer with a version of information that they think is appropriate. Notwithstanding these problems, it was envisaged that the collection of interview data

would provide insights into the perceptions of parents and educators, who interact much more frequently and informally with congenitally blind children than do researchers. Thus, their views and insights are likely to be more naturalistic and related to everyday events. It was considered that this was likely to be particularly helpful in exploring in greater depth how blind children build up their knowledge and understanding of vision through formal and informal interaction with peers, siblings, educators and parents.

An accurate record of the interview data was produced, which sought to represent faithfully the participants' perspectives by referring, as far as possible, to the actual words they used and the particular ways they expressed themselves (Uzzell, 1995). (This was also true for the other studies where children's verbal responses were reported e.g. Studies 3 and 5 reported in Chapters Nine and Ten respectively).

Section 6.2. drew attention to some important methodological considerations that need to be taken into account when carrying out research with young children, particularly those children who are blind, and when carrying out interviews with adults. Having discussed specific methodological considerations that are particularly relevant for this thesis, participant details will be reported.

6.3. Participants

This section presents details of the adults and children who took part in the empirical studies reported in Chapters Seven to Twelve. The opinions of adults were sought in Study 3 (Chapter Nine), and adults were interviewed in Study 6 (Chapter Twelve).

Formal approval was gained from the Open University Human Participants and Materials Ethics Committee (HPMEC) at the start of the research, and British Psychological Society ethical guidelines were followed throughout. Guidance was also taken from Ethical Principles for Research Involving Human Participants (HPMEC, 2006), and ethical issues will be referred to as appropriate.

6.3.1. Adult participants

An opportunity sample of adults was selected for Study 3. They were not required to give their age, but they ranged in age from late teens to just prior to retirement. They were predominantly White British, but some participants were of Asian or Afro-Caribbean ethnicity and they were drawn from a number of occupational backgrounds, for example students, lecturers, factory workers, sign writers, nurses and teachers, reflecting a range of socio-economic backgrounds.

The participants in Study 6 were the parents and educators of the blind children who had participated in the previous studies.

Participants were given written information about the research and were told what participation would involve; were asked to sign a consent form only after they had been given time to consider their decision; were informed that they could withdraw from the research at any time; and were assured that should they so wish, any data that they provided would be destroyed and that there would be no resultant adverse consequences (HPMEC, 2006, pp.1-2).

6.3.2. Child participants

In accordance with ethical guidelines (HPMEC, 2006, p.2), prior to any contact with children or their families, enhanced disclosure for the researcher was obtained from the Criminal Records Bureau.

Both blind and sighted children were recruited from schools and preschools where the catchment areas were working- and middle-class, from various regions in England.

Blind and sighted children took part in Studies 1, 2, 3 and 4, in order to compare the performance of the blind children with the performance of a sighted control group where appropriate. However, only blind children participated in Study 5, as the task in that study was thought to be inappropriate for sighted children matched by age to the group of blind children.

The inclusion criteria for the blind children were as follows: between the ages of three and 14 years, with light perception or less vision from birth, and with no other known impairments. Congenitally blind children without additional impairments are very rare in the UK. Less than 0.3 per 1000 (0.03%) children are congenitally blind and only 30 per cent of these have no other physical or cognitive impairments (Bouvier & Sinha, 2006), making recruitment of such children problematic. In order to reach as many blind children as possible, a recruitment letter (Appendix 1) was sent to visual impairment professionals in Local Education Authorities (LEAs) in England and Wales, asking them if they knew any children who might meet the inclusion criteria, and if so, to forward a letter (Appendix 2A) to the parents/carers of the child. In accordance with ethical guidelines, the letter briefly explained the aims of the

research, and asked the parents/carers to respond if they were prepared to allow their child to take part (HPMEC, 2006, p.1). In total, 16 children who matched the criteria were recruited. Thirteen of them were of White British ethnicity, and three were of African ethnicity, born in the UK. They came from a range of socio-economic backgrounds. All parents were informed that they could withdraw their child from the research at any time; and were assured that should they so wish, any data that they provided would be destroyed and that there would be no resultant adverse consequences (HPMEC, 2006, p.2).

Further details for the blind children are shown in Table 6.1. Information about the children’s ages will be given in the relevant sections for each of the five empirical studies reported in Chapters Seven to Eleven.

Table 6.1: Characteristics of blind participants					
Child	Age*	Cause of blindness	Gender	Level of vision	
				R	L
B	3;6	Septo-optic dysplasia	m	LP	LP
H	4;10	Septo-optic dysplasia	m	none	none
G	5;10	Retinopathy of prematurity	f	none	none
M	7;1	Retinopathy of prematurity	f	low LP	none
D	7;6	Optic Nerve Hypoplasia	f	LP	LP
O	7;6	Retinopathy of prematurity	f	LP	LP
C	7;8	Lebers amaurosis	f	none	none
As	8;11	Lebers amaurosis	m	none	none
Mo	9;5	Retinal dystrophy	m	low LP	low LP
J	10;2	Retinopathy of prematurity	f	LP	LP
S	10;3	Lebers amaurosis	m	LP	none
E	11;0	Lebers amaurosis	m	none	none
Se	11;2	Anophthalmia	f	none	none
Be	11;8	Retinopathy of prematurity	m	none	none
Ma	13;5	Bilateral microphthalmus	m	none	none
A	14;8	Lebers amaurosis	m	LP	LP

* Age when first recruited

All the blind children attended mainstream schools or preschools, and had received a Statement of Special Educational Needs (SEN), which describes the difficulties that

a child with SEN might encounter in school, and makes recommendations as to how provision might best be made to support the child.

The sighted children were recruited from several educational establishments in the West Midlands: one day-nursery, two primary schools, and two comprehensive secondary schools. The recruitment process differed slightly from study to study. For Studies 1 and 2, a letter (Appendix 2B) was sent to all families of children in the target age-group. In accordance with ethical guidelines, the letter explained the aims of the research, and asked the parents/carers to respond if they were prepared to allow their child to take part (HPMEC, 2006, p.1). For Studies 3 and 4, a letter was sent to all families of children in the target age-group, informing them that the researcher would be in school on a specified date collecting data from various tasks and that if they did not want their child to participate they should opt out by completing a tear-off slip at the bottom of the letter (see Appendix 2C). This was at the request of the Headteachers of the schools involved, and was acceptable to the researcher, as ethical guidelines state that consent can be gained from those acting *in loco parentis* (HPMEC, 2006, p.1). In the event, no sighted children's families opted out. The children ranged in age from 3;6 to 14;8, and they were mainly White British, but some participants were of Asian or Afro-Caribbean ethnicity. These children were all identified as being 'typically developing' by their teachers, and none was on the Special Educational Needs register.

The confidentiality of participants' identities and data was respected throughout (HPMEC, 2006, p.1), and access to the data, both those which were electronically

stored (including video and audio material) and in hardcopy, were restricted to the researcher in accordance with The UK Data Protection Act (1998).

All participants were asked verbally for their consent at each testing phase, and were advised that they could withdraw at any time (HPMEC, 2006, p.1). All the participants remained in the study until the data collection was completed.

6.4. Standardised verbal assessment tests

6.4.1. Description

In order to determine whether significant differences in the verbal IQs of the blind and sighted children could act as a confounding variable in the studies that compared performance of both groups, standardised verbal assessment tests were administered to all children participating in the studies, except for those who contributed to the development of the Ranking Task (Stages 1 and 2 of Study 3). The assessment batteries used were the Weschler Intelligence Scale for Children IIIR^{UK} (WISC-IIIR^{UK}) (Weschler, 1992) for children aged six years and above, and the Wechler Preschool and Primary Scale of Intelligence – Revised^{UK} (WPPSI-R^{UK}) (Weschler, 1990) for children aged between three and six years, which the researcher was trained to use. All six items on the verbal scale of the WISC-IIIR^{UK} were administered to all the children aged six years and over, (N sighted = 68, N blind = 14) and all the items on the verbal scale of the WPPSI-R^{UK} were administered to the children aged between three and six years of age (N sighted = 24, N blind = 0), in order to test verbal ability across blind and sighted participants. The two youngest blind children did not undergo any standardised assessment tests, because although attempts were made in both cases to administer the verbal scale of the WPPSI-R^{UK}, neither child would cooperate.

Access to the data was restricted to the researcher in accordance with the UK Data Protection Act (1998).

6.4.2. Results

The sighted children's verbal IQs ranged from 79 to 148, and the range of the blind children's scores was 81 to 149. The mean verbal IQ scores of the blind ($M = 117.79$, $SD = 19.94$) and sighted ($M = 108.64$, $SD = 16.06$) did not differ significantly ($t = -1.92$, $df = 104$, $p = 0.58$).

6.5. Chapter Summary

Chapter Six drew attention to some important methodological considerations that are relevant for the purposes of this thesis. Details of the participants who took place in the empirical studies were reported, and the recruitment process was described, with reference to pertinent ethical issues.

CHAPTER SEVEN

STUDY 1: BLIND AND SIGHTED CHILDREN'S UNDERSTANDING ABOUT THE ASPECTUALITY OF KNOWLEDGE

7.1. Introduction

Chapters Two and Three reviewed the literature to date on the development of aspectuality. Briefly, adults appreciate there is a relationship between what is perceived and what is known. That is, vision can provide information about the colour of an object, so if the colour blue is perceived through the visual modality, then the observer knows that the object is blue. Similarly, the tactual modality provides information about temperature. Thus, if heat is perceived via the hand touching a hot surface, then the toucher knows that the surface is hot. Adults understand then, that experience is a necessary requirement for knowledge to be attained, and that different types of sensory experience provide different types of knowledge (Dretske, 1981). This understanding is referred to as knowledge of aspectuality (Dretske, 1969; Perner, 1991).

How does children's knowledge about aspectuality develop? Chapters Two and Three reviewed some of the literature to date relating to the development of understanding of the aspectuality of knowledge in sighted and blind children, and outlined the developmental path proposed by O'Neill et al. (1992), in which three discrete stages of understanding are identified. Evidence from a number of studies (e.g. Woolley & Bruell, 1996) indicates that in the first stage of understanding about aspectuality, sighted three-year-olds can succeed on simple visual access tasks, demonstrating that they know that seeing leads to knowing. However, the ability to identify sources of

knowledge depends on the nature of the source involved. Three- to four-year-old sighted children perform well on tasks relating to seeing but not on tasks related to touching. This may be because they have developed an awareness of the *association* between seeing and knowing, but do not yet appreciate the causal links between sensory experience and knowledge (O'Neill et al., 1992).

The second stage of development in sighted children occurs at between four and five years of age. This is when they begin to understand the causal relationship between sensory experiences and knowledge (Wimmer, Hogrefe, & Sodian, 1988). There is some evidence to suggest that some four-year-olds are capable of identifying the sources of their own and others' knowledge when seeing, feeling and telling are the source types in question (Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Wimmer, Hogrefe, & Sodian, 1988).

The final stage of understanding about the aspectuality of knowledge is reached at around six years of age. In a nutshell, when this stage of development is reached children understand that an object's identity is made up of distinct properties that are obtained separately through a person's multi-sensory experiences with the object (O'Neill & Astington, 1990). By six years of age, sighted children's ability to ascribe knowledge to themselves and others, in the tactual and visual modalities at least, is similar to adult performance (O'Neill et al., 1992).

While three- to four-year old sighted children's understanding about aspectuality may be limited to association rather than cause, the visual modality is nevertheless the first modality in which young sighted children's understanding about the modality-specific

nature of knowledge emerges. This is of central importance for this thesis, and raises the question of how blind children, who have no access to the visual modality, come to understand about the aspectuality of knowledge. In the absence of vision, it is unlikely that blind children's understanding of aspectuality will develop in an identical way to that of their sighted peers. Sighted children, in the associative stage of development, are aware of the relationship between seeing and knowing. It is possible that the associative stage for blind children might consist of awareness of the relationship between feeling/touching and knowing, given that once they are mobile, touch is the primary modality through which blind children explore their world.

The purpose of the first study was to address some of the questions that are, to date, unanswered. No study has addressed blind and sighted children's understanding of aspectuality comprehensively by addressing their understanding of all five sensory modalities. Study 1 aimed to investigate both blind and sighted children's understanding about the aspectuality of knowledge across age-groups and sensory modalities. Because the methodology of O'Neill and Chong (2001) elicited much valuable information about young sighted children's understanding of the aspectuality of knowledge, similar tasks were used in this present study to explore both blind and sighted children's knowledge and understanding about how sensory information is acquired. As with O'Neill and Chong's (2001) study, the children were required to indicate how they or other people acquire knowledge, either by verbal description or demonstration. However, where the primary focus in O'Neill and Chong's (2001) study was to assess the effectiveness of different question types (Show, Tell and MPH) in eliciting knowledge about aspectuality from young children, the focus in this current study was to assess children's knowledge levels by combining the scores

across question types rather than by comparison of responses to each question type. In addition to the three question types used by O'Neill and Chong (2001), the children in this current study were also required to find out an object property independently.

In order to investigate the age at which understanding of aspectuality begins to emerge in blind children, and also the age at which this understanding is reliable and firmly established, the sample was divided into older and younger age-groups for the purposes of comparison of performance. Research evidence suggests that sighted children begin to demonstrate some understanding about the aspectuality of knowledge at around three years of age, in the visual modality at least (e.g. O'Neill et al., 1992; Woolley & Bruell, 1996), and that at between three and four years of age there is a dramatic improvement in understanding of aspectuality (O'Neill & Chong, 2001). Similarly, research in the theory of mind tradition suggests that performance on theory of mind tasks improves significantly between the third and fourth year of age (Gopnik & Graf, 1988; Perner, 1991; Wimmer, Hogrefe, & Perner, 1988; Wimmer, Hogrefe, & Sodian, 1988). Sighted children of six years are able to ascribe visual and tactual knowledge to themselves and other people with accuracy, and are similar to adults in their understanding about modality-specific knowledge in these two sensory modalities. There is no available research about blind children's understanding of aspectuality *per se*. There is, however, some evidence to suggest that blind children are delayed in developing a theory of mind (e.g. Green et al., 2004; McAlpine & Moore, 1995). If, as was argued in Chapter Three, developments in theory of mind are crucial to understanding about the aspectuality of knowledge, as has been suggested by some (e.g. Perner, 1991), then it is likely that blind children will be delayed in the development of this understanding. For these reasons, the

sighted children who took part in the study ranged in age from 3;6 to 6;5, while the age-range of the blind children was 3;6 to 9;5, to capture the emergence and attainment of understanding of aspectuality in both blind and sighted children. Based on previous findings, the first hypothesis stated that children in the older groups, both blind and sighted, would score higher on tasks measuring their understanding of the aspectuality of knowledge than would children in the younger groups.

The study was designed to explore which modalities, if any, were better understood as sources of knowledge than others, and also, whether there was any difference in the understanding of blind and sighted children. Because blind children with no more than light perception have no first-hand, experiential knowledge of vision, it is unlikely that they can demonstrate the same levels of understanding of that modality as their sighted peers, but as the blind sample was so small, it was recognised at the outset that statistical analysis to test between-modality differences would not be appropriate. Nevertheless, it was hoped that trends in the data would give some indication of whether sighted children show better understanding of the visual modality than do their blind peers.

Sighted children of three years and above tend to over-estimate the importance of vision as a source of informational access (Woolley & Bruell, 1996). Robinson et al. (1997) propose that this is possibly as a result of the application of a general heuristic containing the familiar association between seeing and knowing, in the absence of other heuristics or rules. It is not to be expected that children who are congenitally blind develop in a similar way to their sighted peers in relation to over-estimating the role of vision in the acquisition of knowledge. It is however possible that they

demonstrate an equivalent bias in their emerging understanding about the relationship between perceptual information and knowledge. Once blind children become mobile, touch is the sense through which they primarily physically examine their world. Thus, it is likely that the touch modality is the one with which they are most familiar. It is possible then, that if there is a corresponding bias, it will be in the tactual modality. The second hypothesis stated that if any such bias were found, it would be most likely toward the tactual modality.

A qualitative shift in knowledge and understanding of aspectuality at between three and four years of age was identified in sighted children by O'Neill and Chong (2001). One explanation is that three-year-olds are unable to reflect on the origins of their own mental representations, and the ability to do so at four-years is possible because of the newly acquired understanding of the mind as representational (e.g. Perner, 1991). Study 1 also sought to explore this possible explanatory factor by administering some standard theory of mind tasks and exploring the relationships between performance on these tasks and on those examining aspectuality. Because of the evidence suggesting that blind children are delayed in developing a theory of mind (e.g. Green et al., 2004; McAlpine & Moore, 1995), the theory of mind tasks were administered to all the children in the study, regardless of age or visual status. Two types of theory of mind tasks were used: a misleading container task and a changed location task. This was based on Peterson et al.'s (2000) suggestion that more refined perspective-taking skills are needed to succeed on the former than the latter. It was intended that the inclusion of both tasks would provide the children with the opportunity to demonstrate even an emerging understanding of mind. The third

hypothesis stated that children who scored well on the theory of mind tasks would also score well on the aspectuality tasks.

7.2. Method

7.2.1. Participants

Eight congenitally blind children aged between 3;6 to 9;5 ($M = 86.13$ months, $SD = 22.14$ months) took part in the study. They had at most light perception from birth and no other known physical or cognitive impairments. They were recruited, following ethical guidelines (HPMEC, 2006) as described in Section 6.3.2., from schools and pre-schools where the catchment areas were working- and middle-class, from various regions in England. Seven of them were of White British ethnicity and one was of African ethnicity, born in the UK. They came from a range of socio-economic backgrounds. Further details are shown in Table 7.1.

Table 7.1: Characteristics of blind children participating in the Understanding Aspectuality and Theory Mind tasks

Child	Age	Cause of blindness	Gender	Level of vision	
				R	L
B	3;6	Septo-optic dysplasia	m	LP	LP
G	5;10	Retinopathy of prematurity	f	none	none
M	7;1	Retinopathy of prematurity	f	low LP	none
D	7;6	Optic Nerve Hypoplasia	f	LP	LP
O	7;6	Retinopathy of prematurity	f	LP	LP
C	7;8	Lebers amaurosis	f	none	none
As	8;11	Lebers amaurosis	m	none	none
Mo	9;5	Retinal dystrophy	m	low LP	low LP

(LP = light perception)

Thirty sighted children aged between 3;6 and 6;5. ($M = 60.23$, $SD = 11.11$) took part in the study. They were recruited, following ethical guidelines (HPMEC, 2006), as described in Section 6.3.2., from primary schools and day nurseries in the West Midlands, and came from a range of social and ethnic (Afro-Caribbean, Asian and White British) backgrounds. None had any known physical or cognitive impairments.

In order to plot the development of understanding of aspectuality, each group was divided into two age sub-groups. The Younger Blind group were aged 42 to 90 months ($M = 71.76$, $SD = 21.58$), and the Older Blind group were aged 90 to 113 months ($M = 100.5$, $SD = 11.27$). The Younger Sighted group ranged in age from 42 to 59 months ($M = 50.73$, $SD = 5.7$), while the Older Sighted group were aged from 60 to 77 months ($M = 69.73$, $SD = 5.52$). As explained on pp. 113 to 114, the age-range of the blind children was larger than that of the sighted children, in order to encapsulate the emergence and attainment of understanding in both blind and sighted children. Thus, the groups were split differently, with the range of ages larger for the blind than the sighted groups. Further, at this stage of the study, only two blind participants were under the age of 6½ years – the age at which sighted children understand that an object's identity consists of properties that are gained discretely through a person's multi-sensory experiences with the object (O'Neill & Astington, 1990), and can ascribe knowledge to themselves and others, for seeing and touching at least, is similar to adult performance (O'Neill et al., 1992). Had only those two blind children participated, it is possible, given the expected delay in blind children's attainment of understanding of aspectuality, that the study would not have identified the age at which blind children can succeed on tasks measuring this understanding.

7.2.2. Aspectuality

7.2.2.1. Design

A baseline test and two experimental tasks were administered. Naming Sensory Organs was a baseline test to assess whether the children knew the names and locations of the sensory organs. Most children can name their own and others' sensory organs by the age of 24 months (Bayley, 1969). Although the children participating in

this study were well above that age (youngest aged 3;6), the task was included to check that all the children had achieved this baseline level of functioning. Had any child scored 50 per cent or less correct responses, they would have been excluded from the study, as this basic knowledge was a necessary requirement for the following tasks to be meaningful.

Two further tasks used four question types in order to give the children maximum opportunity to demonstrate their knowledge of aspectuality. Each task consisted of five trials, one for each sensory modality under investigation (see, feel, taste, touch and smell). The instructions and questions given for each of the modalities were as similar as possible. In the Find Out task the children were asked to **find out** a specific object characteristic (e.g. colour or smell) of an object, to **tell** how she/he had determined the property, and to **show** the researcher how the property had been discovered. In the Mr Potato Head (MPH) task the sighted children were asked to **point to**, and the blind children to **touch**, the sensory organ on the doll that could be used to discover a specific object characteristic. In addition to asking the children to explain how they had determined the object property, the format thus incorporated three non-verbal response options (find out, show and point to) for the children to demonstrate their knowledge. The scores from these two tasks were combined in order to provide a composite measure of understanding of aspectuality.

Each child was tested on all three tasks, which were always administered in the order in which they appear above. The order of the five modalities under investigation (see, feel, taste, touch and smell) was randomised for each child.

7.2.2.2. Materials

Baseline test – Naming Sensory Organs

A Mr Potato Head toy with detachable eyes, nose, mouth, ears and hands was used for the Naming Sensory Organs baseline test. The sensory organs were attached to the doll, in the appropriate locations, at all times.

Task 1 – Find Out

For each of the senses under investigation (see, feel, taste, touch and smell) an object and a corresponding task scenario were constructed. The scenarios were designed to meet two criteria in line with O'Neill and Chong (2001): first, the object property could only be discerned by the use of one sensory modality, for example, taste, so the object supplied no other clues such as colour as to its particular characteristic; second, the children did not have to perform any intermediary action such as lifting the object to find out the required information.

The materials used were as follows. For the Touch trial, a small foil dish containing cold tap water was used. The children needed to place their fingers into the water to find out the temperature (choice: cold or warm). For the Hear trial, an audiotape player with built-in speakers, set at very low volume, played a tape of the researcher talking to someone. The children needed to place their ear close to the speaker to determine the sound (choice: talking or singing). For the See trial, a small yellow ball was placed inside a tall paper gift bag. This prevented the children from touching the ball (to eliminate the possibility that they may cite 'touching' as their knowledge source if they had touched as well as seen the ball), and necessitated that they (or, for the blind children, indicate that another person) look inside the bag in order to find out

the colour of the ball (choice: blue or yellow). For the Smell trial, a small, plastic, opaque, dark brown bottle containing lemon scented, colourless bath oil was used. The children needed to sniff near the small aperture in the bottle to find out the scent (choice: lemon or strawberry). For the Taste trial, a clear, disposable, plastic beaker was filled with plain tap water. The children needed to take a sip of the water to find out the flavour of the water (choice: sweet or plain).

Task 2 – Mr Potato Head (MPH)

The same Mr Potato Head with detachable eyes, nose, mouth, ears and hands was used as for the Naming Sensory Organs baseline test. Again, the sensory organs were attached to the doll, in the appropriate locations, at all times.

7.2.2.3. Procedure

The tasks were administered either in the children's own homes or in a quiet area in their schools, whichever was most convenient for the child's family. A copy of the proforma upon which the responses were recorded and scored can be found in Appendix 3.

The child and the researcher spent a short time chatting in order for the child to be put at ease. When the researcher judged that the child was comfortable and relaxed, she invited the child to sit with her at a table and then said to the child: *"Today, we're going to play some games. I'll show you some of the toys, and then I'll tell you what we're going to do. Does that sound ok?"* Care was taken to ensure that the blind children were given sufficient time to explore all the materials tactually where appropriate.

Baseline test – Naming Sensory Organs

The Naming Sensory Organs task involved two trials, one that assessed the children's ability to name the sensory organs on Mr Potato Head, and one that assessed their ability to identify those organs on their own bodies. Mr Potato Head was introduced, and the child was given the opportunity to explore the toy manually. The child was asked to name Mr Potato Head's sensory organs (hands, ears, eyes, nose and mouth) as the researcher pointed to them in turn, and then asked to point to his or her own sensory organs as the researcher named each one. The procedure was exactly the same for the blind and sighted children except that the researcher guided the blind child's hand to each sensory organ in turn before asking the child to name it. Had there been blind participants without eyes as in anophthalmia, they would not have been asked to point to their own eyes.

Task 1 – Find Out

The Find Out task involved five trials, each corresponding to exploration of a specific sensory modality. The Hear trial will be described below as an example (see Appendix 3 for details of the remaining trials). An audiotape player with built-in speakers, set at very low volume, played a tape of the researcher talking to someone. The researcher said, *"Here's a tape player. Can you find out whether the tape is music or someone talking and tell me?"* The researcher did not give any clue as to how the child should find out whether the tape was playing music or talking. After the child had responded (whether appropriately or not), the researcher asked, *"How did you find out that the [object] is [the type that the child had claimed]?"* Thus, for the Hear trial, the researcher asked, *"How did you find out that the tape is playing talking music?"* Finally, the child was instructed, "Show me how you found out that the

[object] is [the type that it is]”. So for the Hear trial the instruction was, *“Show me how you found out that the tape is playing talking [music].”* The correct response was that the child repeated the action he/she had carried out initially. The entire procedure was repeated for the remaining four modalities (touch, see, smell and taste) and their corresponding objects and scenarios (cold water, yellow ball, lemon bath oil and plain water).

In order to make the See trial accessible to the blind children, the procedure was modified for them. They were shown the same materials, but a sighted peer, teacher or parent, depending on availability, was needed to find out the colour of the ball. The procedure was as follows. The researcher said, *“Here’s a bag with a ball inside. Let’s ask [Mum] to find out whether the ball is blue or yellow”*. [Mum] responded, *“It’s a yellow ball”*. The researcher then asked, *“How did [she] find out that it’s yellow?”* Finally, the researcher asked, *“If you could see, can you show me how you’d find out whether the ball was blue or yellow?”*

Task 2 – Mr Potato Head

The MPH task involved each of the five scenarios and objects used in the Find Out task, but in this case the child was asked to point to the sensory organ Mr Potato Head would need to use to find out the specific property of each object. Thus, for the Hear trial the researcher placed the audiotape player on the table in front of Mr Potato Head and said, *“Here’s a tape player. Can you show me what Mr Potato Head will need to use to find out whether the tape is music or someone talking?”*

7.2.2.4. Scoring

Baseline test – Naming Sensory Organs

For the baseline test, one point was awarded for each sensory organ named correctly on Mr Potato Head, and for each sensory organ identified correctly on the child's own body. Thus, a maximum score of 10 points was possible.

Task 1 – Find Out

For the Find Out task, one point was awarded for each component part of each trial. So, for example in the Touch trial, the child would be awarded one point for placing his or her fingers in the water to determine whether the water was warm or cold. A further point was given for verbally stating how she/he had discovered the property in question, for example, "I touched it", or, "With my hand". Provision was made for a non-verbal response (although no child actually responded in this way), so if the child were to point to the appropriate sensory organ (in the case of the Touch trial, hand or fingers) or repeated the action, a score of 0.5 would be awarded. Finally, a point was awarded if the child was able to demonstrate the appropriate action when asked to show the researcher how he/she had found out. Again, in the case of the Touch trial, the child needed to place his/her hand in the water again. If she/he had offered only a verbal response, and did not demonstrate the necessary action, a score of 0.5 would have been awarded, but in the event, no child responded in this manner. A maximum score of 15 points was possible for the sighted children and 14 points for the blind children, as they could not 'find out' for themselves what colour the ball was in the See trial. In order to address this discrepancy and achieve parity between the sighted and blind children, the points gained by the sighted children in the 'find out'

component of the See trial were discounted in all analyses that made direct comparison of the scores of blind and sighted children.

Task 2 – Mr Potato Head

Children received a score of one point if, in response to the questions in the MPH task, they selected the correct body part connected to the specific sensory modality in question, either by naming it, or by pointing to it. A maximum score of five points was therefore possible for this task.

7.2.3. Theory of Mind

7.2.3.1. Design

A Changed Location task and a Misleading Container task (both standard theory of mind tasks) were administered to the children in order to investigate a possible relationship between the development of theory of mind and knowledge of aspectuality. The Changed Location task was administered first, followed by the Misleading Container task. With hindsight, it would have been better to counterbalance presentation of the tasks, as this would have eliminated a possible order effect. As with the Understanding Aspectuality tasks, the scores were combined to provide a composite measure of Theory of Mind.

7.2.3.2 Materials

Changed Location

The Changed Location task utilised three pencil cases, which were tactually (in order to allow the blind children to distinguish between them) and visually very different from one another. One was made of tin, one of fur and one of plastic. A biro-type pen

was used as the object that was moved from one pencil case to another. The children's responses were recorded on a proforma (Appendix 3).

Misleading Container

A CD case with an opaque, non-descript cover, giving no photographic or textual cues to suggest a particular artist to sighted children, was used as the misleading container, and inside it was a small sticking plaster.

7.2.3.3. Procedure

Changed Location

Before the tasks were administered, the researcher briefed a peer who was to act as a confederate (as recommended by Peterson and Siegal (1998), discussed in 6.2.1.2.). Teachers or parents were also asked to suggest a friend of the child's, whose name could be used for the second part of the misleading container task.

In the changed location task, the researcher showed the child the three pencil cases and commented on the texture, shape etc., and allowed the child, whether blind or sighted, to explore them tactually.

The researcher then said, "[Confederate] is going to choose a pencil case to keep his/her pen in." The confederate 'chose' the furry pencil case and placed the pen inside, saying, "I think I'll put the pen in this one – the furry one". The sighted children watched whilst this took place. The blind children were invited to feel inside the furry pencil case to 'check' that the pen was there. The confederate then left the room, commenting that he/she was leaving to get something from another room. The

researcher then said conspiratorially, in a low voice, *“Let’s move the pen to a different pencil case. Take it out of the furry pencil case and put it in the tin pencil case”*. When the child had moved the pen the researcher asked, *“When [Confederate] comes back, which pencil case will she/he look in for her/his pen?”* (prediction question). In order to ensure that the children’s responses were related to their understanding of mind, rather than to memory failure, memory of critical events was checked by the use of four control questions, which were asked in the following order: 1. *“Where is the pen now?”* 2. *“Where was the pen at the beginning?”* 3. *“How did the pen get into the tin pencil case?”* 4. *“Did [Confederate] see us move the pen?”* In the event, all children answered the control questions correctly. Finally, the researcher asked, *“Why will [Confederate] look there?”* (explanation question).

Misleading Container

The Misleading Container task had two parts, each with a prediction and an explanation question. In the first part, the researcher handed the CD case to the child and said, *“Here’s a plastic case.”* The child was invited to explore the case tactually, but not to open it. Then the researcher asked, *“What do you think is inside the case?”* When the child had responded, the researcher asked, *“Why do you think it’s a [CD]?”* The child was then invited to open the CD case and see if they had been correct. The researcher then asked the two test questions for the first part of the task: *“What did you think was in the box before you opened it?”* (pre-knowledge prediction), followed by: *“Why did you think that?”* (explanation). The second part of the task involved asking two further questions of the child: *“What would [Friend] think was in the box if he/she felt it?”* (prediction), followed by: *“Why would [Friend] think that?”* (explanation).

7.2.3.4. Scoring

Changed Location

For the Changed Location task, the scoring was the same as used by Kloo and Perner (2003). Answers to the explanation question were classified into categories shown in Table 7.2.

Table 7.2: Response categories for the Changed Location task

a	Mental state, e.g. She didn't see me move it
b	Relevant event facts, e.g. She put it in the furry one
c	Desire answer, e.g. She wants the pen
d	Wrong location, e.g. Because it's here now
e	Moved it, e.g. Because we moved it
f	Irrelevant event or information, e.g. She draws with pens
g	No answer/don't know/I/he just will

Answers in categories a) and b) were classified as correct, indicating an understanding of belief, while answers in the remaining categories were classified as incorrect. If the child correctly predicted that the confederate would look in the furry pencil case, one point was awarded. If they gave an explanation for this action from category a) or b), then a further point was awarded. A maximum of two points was therefore possible on this task.

Misleading Container

A similar procedure was adopted for the Misleading Container task. Responses to the explanation question were classified into categories (Table 7.3.).

Table 7.3: Response categories for the Misleading Container task

a	Mental state, e.g. I (she) know(s) that CDs are usually in those boxes
b	Relevant event facts, e.g. Because that's a box for CDs
c	Desire answer, e.g. Because I (she) like(s) CDs
d	Wrong location, e.g. You've put it in the wrong box
e	Moved it/changed it e.g. Somebody's moved the CD/plaster
f	Irrelevant event/information, e.g. If he falls he can put it on
g	No answer/don't know/I/he just will

For the question relating to their own pre-knowledge prediction - “What did you think was in the box before you opened it?” - if the child correctly said that they had believed initially there was a CD in the box, one point was awarded. If they gave an explanation for this belief from category a) or b), then a further point was awarded. In the question relating to the belief of a friend, “What would [Friend] think was in the box if he/she felt it?” one point was awarded for the correct response of “CD”. If this belief was explained by an answer from category a) or b), then a further point was awarded. Thus, a total of four points could be gained in the Misleading Container task.

The total possible score for the theory of mind tasks was 6 points.

7.3 Results

7.3.1. Naming Sensory Organs

In the Naming Sensory Organs task, all the children scored 100 per cent correct responses, except for one sighted child aged 4;5, who scored nine out of 10 correctly, failing to point to the hands on Mr Potato Head, and the youngest blind child, aged 3;6, who also scored nine out of 10 correctly, being unable to point to the eyes on Mr Potato Head. No further analyses were carried out on these data. Thus, all the children were deemed to have enough knowledge about the names and locations of their sensory organs to be included in the study.

7.3.2. Aspectuality

The data were not normally distributed so non-parametric Mann-Whitney U tests were used. However, since the data were not ordinal and can be reasonably considered as

interval, the mean scores and standard deviations will be reported rather than the range and median.

The data from the Find Out and MPH tasks were combined to give a composite measure of understanding aspectuality of knowledge (maximum possible score 19).

The data were first considered by age-group and visual status. The Younger Blind children ($M = 11.75$, $SD = 5.25$) scored at a significantly lower level than the Older Blind children ($M = 19.00$, $SD = 0.00$) ($U = 0.00$, $N_1 = 4$, $N_2 = 4$, $p = <0.05$, one-tailed). The difference in the scores of the Younger ($M = 8.00$, $SD = 5.70$) and Older Sighted children ($M = 16.00$, $SD = 2.48$) were also significant with the Older children achieving higher scores ($U = 23.50$, $N_1 = 15$, $N_2 = 15$, $p = <0.001$, one-tailed). Thus, the results supported the first hypothesis that both blind and sighted children in the older age-groups would perform better on tasks measuring their understanding of aspectuality than would children in the younger age-group. There was no difference in the scores of the Younger Blind ($M = 11.75$, $SD = 5.25$) and Younger Sighted ($M = 8.00$, $SD = 5.70$), groups ($U = 16.00$, $N_1 = 4$, $N_2 = 15$, $p = 0.08$, one-tailed), but the Older Blind children ($M = 19.00$, $SD = 0.00$), performed significantly better than the Older Sighted children ($M = 16.00$, $SD = 2.48$) ($U = 8.00$, $N_1 = 4$, $N_2 = 15$, $p = <0.005$, one-tailed).

To summarise, children with congenital blindness scored at similar levels to their sighted peers on tasks that measured their overall understanding about the aspectuality of knowledge. Blind children below the age of 90 months are not secure in their knowledge of aspectuality, but given the clear choice for children in these tasks,

among 19 possible choices (i.e. the five body parts over three trials and four body parts over one trial) can be compared with that expected by chance (i.e. a score of four over 19 trials). Their overall performance was much better than would be expected by chance ($M = 11.75$, $SD = 5.25$). Blind children above the age of 90 months were secure in their knowledge of aspectuality, and scored 100 per cent, at ceiling. The results in this study reflected those in earlier studies (e.g. O'Neill & Chong, 2001) that secure understanding about the aspectuality of knowledge emerges in sighted children at around six years of age, with the Older Sighted children scoring significantly higher than the Younger Sighted. Although the Younger Sighted children in this current study scored higher than would be expected by chance ($M = 8.00$, $SD = 5.70$) their knowledge was not consistent across the sensory modalities (this will be discussed below). The Older Sighted group achieved high scores ($M = 16.00$, $SD = 2.48$) suggesting that for most of them, their ability to find out, demonstrate and explain how they or another 'person' (in this case a Mr Potato Head toy) could discover a given object property, was comprehensive across the sensory modalities.

The analysis then turned to an exploration of scores across the five sensory modalities addressed in the study (see, feel, taste, touch and smell). The mean scores for the blind and sighted groups for each modality can be seen in Table 7.4. and the raw data for the blind children, can be found in Appendix 10. The maximum possible score for each modality was four except for seeing, when the maximum possible was three.

Table 7.4: Mean score and S.D. in each modality by age and visual status summed across the Understanding Aspectuality tasks

Group		touch	hear	see	smell	taste
Younger Sighted	M	2.33	2.13	1.33	1.73	.53
	N	15	15	15	15	15
	S.D.	1.72	1.96	1.11	1.87	1.13
Older Sighted	M	3.87	3.87	2.73	3.47	2.07
	N	15	15	15	15	15
	S.D.	.35	.35	.59	1.25	1.71
Total Sighted	M	3.10	3.00	2.03	2.60	1.30
	N	30	30	30	30	30
	S.D.	1.45	1.64	1.13	1.79	1.62
Younger Blind	M	3.25	3.25	1.75	3.00	.50
	N	4	4	4	4	4
	S.D.	.96	.96	1.50	2.00	1.00
Older Blind	M	4.00	4.00	3.00	4.00	4.00
	N	4	4	4	4	4
	S.D.	.00	.00	.00	.00	.00
Total blind	M	3.6	3.6	2.38	3.50	2.25
	N	8	8	8	8	8
	S.D.	.74	.74	1.19	1.41	1.98

The scores were then converted to percentages so that scores for Seeing could be compared like-for-like with scores in the other modalities. A comparison of percentage scores by modality, age and visual status can be seen in Figure 7. 1.

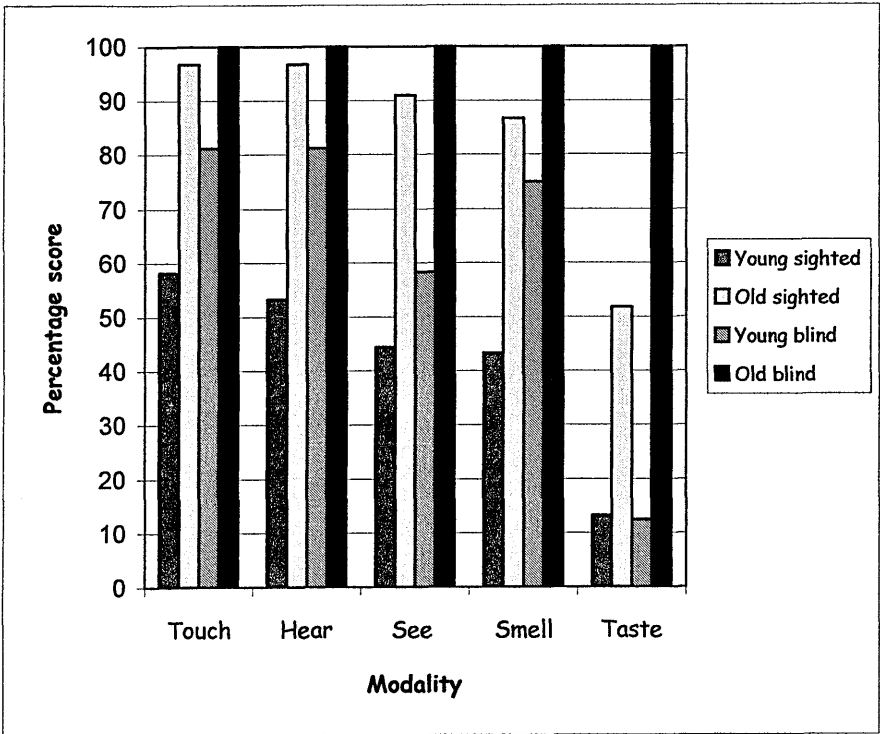


Figure 7.1. Percentage of correct responses on the Understanding Aspectuality tasks by modality, age and visual status

Because the number of children in the blind group was so small ($N = 8$), it was not appropriate to carry out statistical analyses to test for difference in scores between modalities. However, trends in the data are interesting and worth reporting, with all groups except the Older Blind group (who scored 100% in all modalities and will therefore not be discussed further) showing similar patterns of accuracy, except in the See modality. The Younger and Older Sighted children and the Younger Blind children all scored least in the Taste modality (13.25%, 51.75% and 12.5% respectively) and highest in the Touch modality (58.25%, 96.75% and 81.25% respectively), closely followed or achieving equal scores in the Hearing modality (53.25%, 96.75% and 81.2% respectively). However, the Younger and Older Sighted children scored similarly in the Seeing and Smelling modalities (44.33% and 43.25%; 9% and 86.7% respectively), but the Younger Blind children scored lower in the See modality (58.3%) than in the Smell modality (75%).

Where no points were awarded, both blind and sighted children mostly responded that they didn't know, or they 'just know' or refused to respond. The number of actual erroneous responses made by the blind children was so low (only four children made erroneous responses) that it was inappropriate to carry out statistical analyses on the data. Nevertheless, some interesting patterns were observed in the data and these can be seen in Table 7.5.

Table 7.5: Sensory modality chosen in error by sighted and blind children on the Understanding Aspectuality tasks.

Group	Modality trial	Modality chosen in error					
		Touch	Hear	See	Smell	Taste	Total errors
Younger Sighted	Touch	0	0	3	0	4	7
	Hear	0	0	1	2	1	4
	See	7	0	0	3	3	13
	Smell	1	2	2	0	4	9
	Taste	16	0	11	6	0	33
Older Sighted	Touch	0	0	0	0	0	0
	Hear	0	0	0	0	0	0
	See	0	0	0	0	0	0
	Smell	0	0	8	0	1	9
	Taste	15	0	10	13	0	38
Total sighted erroneous choices		39	2	35	24	13	113
Blind							
5;10	See	3	0	0	0	0	3
3;6, 7;1, 7;6	Taste	8	0	1	1	0	10
Total blind erroneous choices		11	0	1	1	0	13

The hypothesis that blind children tend to over-estimate the importance of touch as a source of informational access was strongly supported by pattern of data, as can be seen in Table 7.5. The tactual modality was chosen in error by blind children 11 times out of a total of 13 erroneous choices. Sighted children also chose touch erroneously more frequently than any other modality and they also overestimated the role of vision as a source of information. Vision and touch were more or less equally overestimated by sighted children as sources of knowledge. This is in line with previous findings that sighted children overestimate the knowledge to be gained from seeing, for example, Robinson et al. (1997) and feeling, for example, O'Neill et al. (1992).

Where errors did occur, both sighted and blind children mainly selected touching as the best mode for finding out how the water tasted, and this accounted for 79 per cent of the touch-related errors in sighted children and 73 per cent of the touch-related errors in blind children. In the case of the sighted children, it is also worth considering the vision-related errors. Again, most of these errors were in response to questions about taste (60%). The blind children's errors were few, but it should be remembered that only the two youngest blind children were comparable in age to the sighted children who took part in the study.

7.3.3. Theory of mind

The data on the Theory of Mind tasks were not normally distributed, so non-parametric Mann-Whitney U tests were used. The mean scores and standard deviations are shown in Table 7.6.

Table 7.6: Mean score and SD by age and visual status on the Theory of Mind tasks

Group	Mean (max. possible 6)	N	S.D.
Younger Sighted	2.13	15	2.47
Older Sighted	5.33	15	.976
Total Sighted	3.73	30	2.46
Younger Blind	3.25	4	3.20
Older Blind	6.00	4	.00
Total Blind	4.63	8	2.56

As no predictions had been made about scores on the theory of mind tasks alone, two-tailed results are reported. When the scores for the two tasks were pooled across age-groups, the blind children performed at a similar level to the sighted children, and the Mann-Whitney U test showed that the difference in overall scores was not significant ($U = 88, N_1 = 30, N_2 = 8, p = 0.217$, two-tailed).

The data were then considered by age-group and visual status. There was no difference in the scores of the Younger and Older Blind children ($U = 4.000$, $N_1 = 4$, $N_2 = 4$, $p = 0.343$, two-tailed). However, the difference in the scores of the Younger and Older Sighted children was significant, with the Older children achieving higher scores ($U = 35.00$, $N_1 = 15$, $N_2 = 15$, $p = 0.001$, two-tailed). There was no difference in the scores of the Younger Blind and Younger Sighted groups ($U = 22.00$, $N_1 = 15$, $N_2 = 4$, $p = 0.469$, two-tailed), nor the Older Blind and Older Sighted children ($U = 20.00$, $N_1 = 15$, $N_2 = 4$, $p = 0.357$, two-tailed).

In sum, significant differences in scores on the Theory of Mind tasks were only found between the Younger and Older Sighted children. The remaining comparisons showed that the blind and sighted children performed at similar levels when the data were pooled, there was no difference between scores in the Older and Younger Blind groups, nor between the Younger Blind and the Younger Sighted, nor the Older Blind and Older Sighted groups. However, given the small size of the blind groups, this is not surprising. The youngest blind child in the study did not score any points for the theory of mind tasks, and the next oldest child aged 5;10 scored only one point on the prediction question in the first part of the Misleading Container task. The remaining 6 blind children (aged 7;1 to 9;5) all made 100 per cent correct responses.

Finally, the relationship between success on theory of mind tasks and success on aspectuality tasks was explored. After controlling for age effects, there was a significant positive partial correlation between scores on aspectuality and theory of mind tasks for the sighted children (partial $r = 0.641$, $n = 30$, $p < 0.001$, one-tailed), in their case supporting the hypothesis that children who score high on theory of mind tasks also obtain high scores for aspectuality tasks, and that this is independent of age.

However, the relationship between scores in the two tasks in the case of the blind children was not significant (partial $r = 0.292$, $n = 8$, $p = 0.263$, one-tailed).

7.4. Discussion

The purpose of the current study was to explore understanding about the aspectuality of knowledge in both blind and sighted children comprehensively by addressing their understanding of all five sensory modalities. The results of the baseline assessment task were very clear: both the blind and sighted children in the study demonstrated the ability to name and point to the five sensory organs, both on themselves, and on Mr Potato Head, and the only errors were the failure of a sighted four-year-old to point to the hands of Mr Potato Head when asked, and the inability of a blind three-year-old to point to the eyes on Mr Potato Head. All the children in the study were able to identify the sensory organs on their own bodies, and it was concluded that by the age of three-and-a-half years, blind and sighted children have the ability to name and identify all five sensory organs on their own bodies.

Consistent with previous findings (e.g. O'Neill et al., 1992), a clear developmental trend was identified in the case of the sighted children, with Older children performing significantly better than younger children on tasks that measured their understanding of aspectuality. The same trend was identified in the case of the blind children, but they were older than the sighted children when they achieved secure knowledge of aspectuality. In line with earlier findings (e.g. O'Neill et al., 1992) that sighted children reach a mature adult-like understanding of aspectuality at between six and seven years of age, four out of six sighted children aged 73 months and above scored at ceiling, while only the four oldest blind children, who were aged 90 months

and above achieved 100 per cent correct responses. This suggests that blind children are delayed by around one year in understanding in this area. What factors might be responsible for this delay?

As there was no difference in the scores of the Older and Young blind children on the tasks that investigated theory of mind, it seems safe to rule out development in this area. It is unfortunate that the blind sample was too small to allow for testing of between-modality differences in scores, because visual scrutiny of the data would seem to offer some explanation of where the differences between Older and Younger blind children lie. Scores on touch, hearing and smell were similar, but there were large discrepancies between scores in the visual and taste modalities (see Figure 7.1). In the visual modality Older and Younger blind children scored 100 per cent and 58 per cent respectively, while in the taste modality, the Older children again scored 100 per cent, compared to 12.5 per cent for the Younger children.

It is possible that it was low scores in these two modalities that caused an overall significant difference in scores between the Older and Younger groups. Lack of direct personal experience in the visual modality is most likely the cause of the low scores of the younger children on questions relating to seeing, if such direct experience is the main source of knowledge, as suggested by Massey and Roth (1997). It is possible that the Olderer blind children demonstrated an excellent understanding of vision because they had begun to fill in the gaps in their knowledge about seeing through asking questions, incidental conversation and direct teaching about vision in school, and this is an area that will be investigated in Study 6, reported in Chapter Twelve. It is less easy to explain the differences in knowledge about the taste modality, but it is

important to note that all children apart from the Older blind group experienced problems in this area. Given that vision and the lack of it is the focus of this thesis, no further comment will be made about the taste modality, except to point out that this is an area that would benefit from further research, in the case of sighted as well as blind children. Further, interventions of the type reported by Massey and Roth (1997), discussed in Chapter Two (Section 2.5.), may improve children's understanding of the taste modality.

In terms of links between theory of mind and knowledge of aspectuality, there was a positive correlation for the sighted children on scores in both tasks, which was independent of age. This was not true for the blind children and this is clearly illustrated in the case of the two youngest blind children. Although the youngest blind child scored zero on the theory of mind tasks, he was able to find out whether the tape was playing speaking or music and whether the water in the bowl was warm or cold. He was also able to demonstrate how he had found out the information. The blind child aged 5;10 scored one point (16%) on the theory of mind tasks compared to 64 per cent on the aspectuality tasks, where she gained some points in every modality, and demonstrated most knowledge in the touch and hearing modalities. It is important to note here that there may have been order effects in the Theory of Mind tasks, as the two tasks were always presented in the same order, with the Changed Location task first, followed by the Misleading Container task.

Clearly then, blind children's understanding of aspectuality, at least in its emerging form, relies on something other than underlying competencies associated with theory of mind. This may be best explained in terms of *association* between experience and

knowledge. Where sighted children tend to understand that seeing leads to knowing, these two blind children at least, demonstrated that they had some knowledge of the association between hearing/touching and knowledge; presumably because these are the two modalities with which they have most experience.

One of the most interesting findings to emerge from the data was the tendency of both blind and sighted children to over-estimate the role of touch in the acquisition of sensory information. When they were in a situation where they did not know how to find out the required object property, they frequently opted for the tactual modality. It is difficult to convey the level of confusion experienced by many of the children, both sighted and blind, as they attempted both to find out a property, and to answer questions about the source of their knowledge. Many children performed or named actions that could not possibly have led to the knowledge in question. For example, a sighted child aged 4;6, when asked to find out if the water was sweet or plain, whispered repeatedly to herself “sugary or plain” before dipping her fingers in the water and saying hesitantly “plain, yes ... plain”. Further, there often seemed to be a lack of awareness about how their sensory action was linked to the knowledge of the property gained only seconds earlier. This was true both when they had tried to get the information using the wrong modality and even when they had found out the property appropriately. For example, in the case of the sighted child aged 4;6 referred to above, who ‘found out’ that the water was plain by touching it, when asked to show how she had found out that the water was plain, peered exaggeratedly at the cup of water, and when asked to tell how she knew, said “Well, I saw it. I looked at it so I knew it was plain”.

This type of unawareness was also demonstrated when a child had found out a property using the correct modality. For example, a sighted child aged 4;6 sniffed the bath oil and correctly said that it was lemon, but when asked how she knew it was lemon replied, "Because I'm looking at it" and when asked to show how she had found out, stared intently at the bottle with wide eyes. The children in O'Neill and Gopnik's (1991) study behaved similarly, and the authors commented that these answers were particularly surprising, when presumably, all the children needed to do was use the strategy of referring back to the action they had just performed, even if they did not explicitly understand the significance of that action in relation to their knowledge of the object property.

Occasionally, children seemed to work towards the correct response through initially making an incorrect choice and then changing their mind. For instance, when asked to find out whether the water was plain or sweet, a sighted child aged 5;5 placed his fingers in the beaker containing the water and said 'It's really, really plain. I've put my hand in and I can't feel the sugar ... [*hesitates*] ...I know, I can't really tell, so I'll taste it and then I'll know for sure'. He went on to name the property correctly and answer the show and tell parts of the trial correctly.

Some children suggested a combination of actions to find out a property. When a blind child aged 7;1 was asked, "If you could see, can you show me how you'd find out whether the ball was blue or yellow?" she replied, "You'd put your hand in first ... like this [*demonstrates*], then you'd look in the bag ... like this [*demonstrates*]". This may of course suggest that the child's own lack of vision led to her underestimation of the importance of vision as a source of informational access, but

similar beliefs about combinations of modalities were observed in the sighted children. For example, a child aged 5;6 said that Mr Potato Head could use his mouth to find out if the water was plain or sweet "... but if he uses his hand and his mouth, that will be better".

Four Younger sighted children suggested that Mr Potato Head should taste the water in the touch trial to find out if it was hot or cold. This response is understandable, given that people often find out the temperature of a liquid when they drink it. Steps had been taken to prevent this by presenting the water in a plastic bowl rather than a cup, but with hindsight, it would probably have been less confusing for the children had the water been presented in a miniature, toy swimming pool (as in O'Neill & Chong, 2001) or even a miniature toy bath. Interestingly, two of the four children who made this response in the MPH task were able to find out the temperature of the water for themselves by dipping their fingers into the bowl, and to show and tell correctly how they had found out that it was cold, while the other two were unable to find out at all.

The discussion now turns to performance on the theory of mind tasks. Two main findings emerged. The third hypothesis predicted that children who performed well on the theory of mind tasks would also perform well on the aspectuality tasks, and this was true for the sighted children, but not for the blind, as discussed above. Second, the performance of the blind children aged 7;1 to 9;5 was exceptional: all made 100 per cent correct responses. This is not in line with some previous findings. For example, McAlpine and Moore (1995) administered two misleading container tasks to 16 visually impaired children with a mean age of six years, six of whom had visual

acuity of only 20/400 or were totally blind. They found that all six had difficulties with concepts of false belief. Four of them failed both tests, and the two who passed at least one test were both over nine years of age.

Four false belief tasks were administered by Peterson et al. (2000) to 23 blind children aged 5;7 to 12;10 (mean age 9;6), who concluded that blind children aged six years have a serious deficit in false belief understanding that is gradually overcome with development by the age of 12 years. While the blind children in the current study aged 5;10 and below certainly showed evidence of this 'serious deficit', the six blind children aged 7;1 to 9;5 performed at ceiling, without difficulty or hesitation. One reason for this may be that the materials and procedures used in this study were more appropriate for blind children, and facilitated their performance, although Peterson and her colleagues also took great care with the selection and development of tasks and materials (see Section 6.2.1.2.).

There is evidence to suggest that early conversational and social experience contributes to the rapid development of understanding of mind in sighted children (Dunn, 1994), and there is no reason to suggest this is different for children who are congenitally blind. All the blind children in this sample attended mainstream preschool or school, and it is possible that they were exposed to a rich linguistic and social environment from an early age, thus accelerating development of understanding of mind. While some researchers (e.g. Roch-Levecq, 2006) do not give information about the schools attended by blind participants in their studies, who are delayed by comparison to their sighted peers in understanding the minds of others, some, for example Peterson et al. (2000), report that participants were selected from special units for the blind. Furthermore, as reported in Section 6.6.2., the blind children who

participated in the current research had higher than average verbal IQs ($M = 117.79$, $SD = 19.94$). Possibly, this contributed to their scores on theory of mind tasks. Further research might explore whether blind children educated in mainstream schools generally perform better on theory of mind tasks than their peers who are educated in special units or schools for the blind.

In summary, Study 1 was designed to explore blind and sighted children's understanding of aspectuality comprehensively by addressing their understanding of all five sensory modalities. Three hypotheses were tested. The first stated that children in the Olderer groups, both blind and sighted, would score higher on tasks measuring their understanding of the aspectuality of knowledge than would children in the younger groups and the results supported this hypothesis. The second hypothesis stated that blind children would over-estimate the role of touch. The blind children made so few erroneous choices that this hypothesis had to be rejected. However, trends in the data revealed that out of 13 erroneous choices, 11 related to the tactual modality, so it is tentatively suggested that blind children do tend to over-estimate the role of touch in the acquisition of sensory information, and further research in this area would be of great interest. Finally, it was predicted that blind and sighted children who performed well on theory of mind tasks would perform well on aspectuality tasks. The findings supported this prediction in the case of the sighted children but not the blind.

A number of further findings are noteworthy. First, by the age of five-and-a-half to six-and-a-half years, sighted children demonstrated an understanding of the aspectuality of knowledge that was almost at adult level ($M = 16/19$). The blind

children reached this stage at around seven-and-a-half years ($M = 19/19$), and scores in the two groups were not significantly different. Second, both the blind and the sighted children experienced difficulties in understanding the taste modality. Third, (although this was not statistically analysed) trends in the data suggested that both blind and sighted children over-estimated the importance of touch as a source of informational access. Sighted children also over-estimated the role of vision. Fourth, between-modality statistical comparisons were not possible, but again trends in the data suggested that the blind and the sighted children demonstrated most understanding of the auditory and tactual modalities. Finally, the blind children in this study demonstrated an earlier grasp of understanding of mind than has generally been shown in other studies.

Having considered knowledge about each sensory modality in the present study, the study reported in the next chapter Study 2 focuses on two modalities, viz. vision and hearing, in more detail. These modalities were selected for closer examination because, first, vision is of particular interest as it is the main focus of the thesis, and Study 2 will explore whether blind and sighted children's ability to take the visual perspective of another person is influenced by the manipulation of distance, occlusion and orientation of both the viewer and the viewed. Second, both blind and sighted children demonstrated a very good understanding of the auditory modality in Study 1, and it may be that there is some equivalence in the auditory experiences of blind and sighted children given that auditory information cannot be seen. Therefore, both blind and sighted children's understanding of the effects can be explored from what may be described as a fairly 'level playing field'.

CHAPTER EIGHT

STUDY 2: BLIND AND SIGHTED CHILDREN'S UNDERSTANDING OF THE VISUAL AND AUDITORY EXPERIENCES OF ANOTHER PERSON

8.1. Introduction

Having considered blind and sighted children's understanding about vision, audition, olfaction, touch and taste, the focus now turns to their understanding of the visual and auditory modalities in more depth.

These two modalities were selected because first, blind children's understanding about vision is the topic of this thesis, and second, given that auditory information cannot be seen, there is likely to be some equivalence in the auditory experiences of blind and sighted children. Although the same might be said of touch, tactual information is usually accompanied by a view of the object or scenario, as touch is only possible at close proximity, whereas sounds can be heard from a distance.

Orientation of both the viewer and the viewed (e.g. Bigelow, 1991a; Nock et al., 2004), distance (e.g. Bigelow, 1988, 1991a; Nock et al., 2003a, 2003b; Nock et al., 2004) and the presence of barriers (e.g. Bigelow, 1991a; Nock et al., 2004) have been reported to cause problems for blind children when carrying out visual perspective-taking tasks. In the current study, children were asked to predict whether seeing and hearing were possible when these factors were manipulated. Because the rules of audition are different from the rules of vision, for example, hearing is possible around corners, but vision is not, asking children to make judgments about the possibility of hearing and seeing in the same conditions should elicit evidence of when cross-

modality analogies are being made. For example, if a child (whether sighted or blind) predicts that a small barrier, such as a settee will block vision and also sound, we can postulate that he/she is using a *visual* rule - which, even very young sighted children are sensitive to (Flavell, 1978) - to make a judgement about *hearing*. Similarly, if a child predicts that a small barrier will not block vision (as observed in blind children by Nock et al., 2004), we can hypothesise that she/he may be using an *auditory* rule to make a judgement about *vision*.

The present study was designed to address four hypotheses. First, based on the findings reported in the last chapter and on the basis of previous research (e.g. Bigelow, 1991a; Bigelow, 1991b), it was predicted that sighted children would perform better than blind children on visual perspective-taking tasks that explored the effects upon vision of distance, occlusion and orientation of both the viewer and the viewed.

There is very little literature concerned with the development of understanding of the general principles or rules about auditory perception, such as how distance affects hearing, or how sound can travel around bends and corners and is not dependent upon straight lines, as is the case for vision. Where literature does exist, it tends to be related to aspectuality or theory of mind in general, rather than treated separately. Despite this dearth of research, one study is worth attention here. Three- and four-year-old sighted children, when given a selection of toys that were different in shape, colour and the noise they made, tended to underestimate the role of listening when asked how a puppet or they themselves could find out the sound that each toy made (Pillow, 1993). Two experiments were reported. Experiment 1 had two tasks. For the

first, the experimenter asked the child to decide whether a puppet should look at, listen to or touch a toy in order to find out its shape, colour or sound. For the second task, the child was asked to decide which of two puppets could tell the child a hidden object's shape, colour or sound. Then each puppet received sensory information in a different modality, and the experimenter asked which puppet could tell the child about the sound the toy made (or the colour or shape, depending on which modality was being explored). Both three- and four-year-olds showed a preference for either looking or touching over listening. Pillow (1993) speculated that the children may have understood the modality-specific aspects of knowledge, but simply have had difficulty in taking the visual, auditory or tactual perspectives of the puppets. Therefore, in Experiment 2, in addition to asking what sensory action a puppet should perform, he also asked the children what action they themselves should take to find a particular object property. The children still tended to favour looking and touching over hearing and there was no evidence to suggest that the children could succeed when choosing for themselves any earlier than they were able to make judgements about another person's (in this case, the puppet's) perspective.

As sighted children aged two to five years have demonstrated that they experience some confusion about how auditory information is gained (e.g. Mossler et al., 1976; Pillow, 1993), the second hypothesis in the present study was that sighted children would perform better on tasks that required them to take the visual perspective of another person than on tasks that required them to take the auditory perspective of another person.

There is a similar lacuna in the literature about the development of understanding of the auditory modality in blind children. Where research about blind children and audition does exist, it tends to relate not to their understanding of the rules of auditory perception, but to their performance on auditory-based tasks. (e.g. Ashmead, Wall, Ebinger et al., 1998; Lessard, Pare, Lepore, & Lassonde, 1998). Findings usually demonstrate that blind children are more adept than sighted children at making use of auditory information in order to understand the environment. Ashmead et al. (1998) found that blind children were more skilled than sighted children at identifying which of two sounds was closer to them, and they were more accurate in judging the distance of sounds. There is some evidence from neuropsychology that the auditory pathways of blind 13- to 16-year-olds function more efficiently than those of their sighted peers, but no evidence that brain areas responsible for visual processing actually take over any auditory processing (Naveen et al., 1998a, 1998b). Work with blind and sighted adults supports these findings (e.g. Lessard et al., 1998). It would appear then, that blind children use auditory information more efficiently than do sighted children.

Notwithstanding the focus on performance on auditory tasks rather than understanding auditory rules, when the findings of Ashmead, Wall, Ebinger et al. (1998) and Lessard et al. (1998) are considered, it seems plausible to suggest that blind children may be more skilled than their sighted peers at predicting what another person can hear, given that they are more dependent on information from the auditory modality than are sighted children. In the present study, the performances of both blind and sighted children on auditory and visual perspective-taking tasks were compared in order to establish whether or not this was so. Based on the findings of

Ashmead Wall, Ebinger et al. (1998) and Lessard et al. (1998), and also because blind children are so dependent upon hearing for informing their interactions with the environment and with other people, the third hypothesis was that blind children would be more skilled than their sighted peers at predicting what another person can hear.

Evidence that that blind children have problems applying visual rules when carrying out visual perspective-taking tasks was reported in Chapter Five (e.g. Bigelow, 1991a; Bigelow, 1991b). Drawing on this evidence, the fourth hypothesis stated that blind children would demonstrate greater understanding of the factors that govern hearing than of the factors that govern seeing.

Findings from some studies suggest that blind children may use analogies to their own perceptual experiences in order to understand vision (e.g. Bigelow, 1988; Bigelow, 1992; Nock et al., 2003a, 2003b; Nock et al., 2004). The present study aimed to identify where spontaneous analogies to the auditory system were possibly being used by blind children in visual perspective-taking tasks.

Previous studies have identified flaws in sighted and blind children's understanding of vision, but have not asked children *why* they believe what they do (e.g. Bigelow, 1991a, 1991b, 1991c, 1992; Boydell et al., 2003; Flavell et al., 1991; Massey & Roth, 1997; Moscovitch, 1995; Nock et al., 2003a, 2003b; Nock et al., 2004; E. J. Robinson et al., 1997; Weinberger & Bushnell, 1994). A further aim of this present study was to ask children to explain their predictions in order to gain some insight into how their decisions were made.

8.2. Method

8.2.1. Participants

The same eight congenitally blind children aged between 3;6 to 9;5 ($M = 86.13$ months, $SD = 22.14$ months), and 30 sighted children aged between 3;6 and 6;5 months ($M = 60.23$, $SD = 11.11$), who took part in Study 1 also participated in Study 2 (see Section 7.2.1). Further details for the blind children can be found in Table 7.1. None of the children had a diagnosed hearing impairment. (Refer to Section 6.3.2. for detailed information on recruitment and ethical considerations.)

8.2.2. Design

Two experimental tasks investigated the children's ability to predict what effects the parameters of distance, barriers and orientation have upon the auditory experience and the visual experience of another person. These were called the Understanding Hearing task and the Understanding Vision task respectively. There were eight trials for each modality, which will be described below. The order of the eight trials was randomised for each child, and this order was used for both tasks. Each child was tested on both tasks. The order of presentation was counterbalanced within each group (i.e. for half of the children Understanding Hearing was presented first, and for the remainder, Understanding Vision was presented first to control for order effects).

8.2.3. Materials

The researcher produced a small diagram upon which the pre-selected locations were marked before the trials began. A copy of the proforma upon which the diagram was drawn and the responses were recorded and scored, with details of each task can be found in Appendix 5.

Understanding Hearing

A small ‘jingle bell’ was used as a noise source in the Understanding Hearing task. In order to aid the children in their responses, and to eliminate the need for a verbal response, the children were asked to hold up a pair of false ears from a Mr Potato Head doll if they thought the Listener could hear the bell in a number of pre-selected locations, or to hide the ears behind their own backs if they did not think that the Listener could hear the bell.

Understanding Vision

In the Understanding Vision task the detachable eyes from a Mr Potato Head toy were used by the child to indicate whether he/she thought that the Viewer could see or not see the researcher and the child from various pre-selected locations. The children were asked to hold the eyes close to their own heads to indicate that they thought they could be seen, or to hide the eyes behind their own backs to indicate that they thought they could not be seen.

8.2.4. Procedure

Before the tasks were administered, the researcher briefed a peer, who was to act as a confederate (recommended by Peterson and Siegal (1998), discussed in 6.2.1.2.). The confederate is referred to in these tasks as the Listener/Viewer (L/V). The researcher selected eight locations around the home or school, before starting the trials. The selection of these locations was based on the evidence that blind children have difficulty on visual perspective-taking tasks investigating understanding of the effects on vision of the orientation of both the viewer and the viewed (e.g. Bigelow, 1992; Nock et al., 2004), distances of over one metre (e.g. Bigelow, 1988, 1991a; Nock et

al., 2003a, 2003b; Nock et al., 2004), and the presence of occluding barriers (e.g. Bigelow, 1991b; Nock et al., 2004). Four of the locations were positions for the child and researcher (C&R), and four were for the L/V. The locations were selected to allow the C&R and the L/V to be at a distance of either one-metre or 15- to 20-metres apart, with or without a barrier (e.g. armchair) between them, and either facing towards or away from one another. The eight positions can be seen in Table 8.1.

Table 8.1: The eight positions in the Understanding Hearing and Understanding Vision tasks

Trial	Position			
	Distance	Barrier	Orientation	Code
1	1m.	No	L/V facing towards C&R	near/facing
2	1m.	No	L/V facing away from C&R	near/L/V away
3	1m.	No	C&R facing away from L /V	near/C&R away
4	1m.	Yes	L/V facing towards C&R	near/barrier/facing
5	15-20m.	No	L/V facing towards C&R	far/facing
6	15-20m.	No	L/V facing away from C&R	far/L/V away
7	15-20m.	No	C&R facing away from L /V	far/C&R away
8	15-20m.	Yes	L/V facing towards C&R	far/barrier/facing

Understanding Hearing

A small ‘jingle bell’ was used as the noise source in the Understanding Hearing task. Because of possible differences in acoustics, the researcher, together with an available adult, checked that the bell could not be heard over the 15- to 20-metre distance before the child was familiarised with the locations.

Most of the locations were indoors, but in some homes, the 15- to 20-metre trials had to be conducted outside, because of space constraints. The barriers were selected on the basis that the L/V could be completely hidden behind the barrier when crouching down, but not so tall or wide that they created a separate space within the environment, such as when there is a dividing wall. Every effort was made to ensure similarity of barriers, so mostly chairs, settees, breakfast bars, dressers, sideboards and brick barbecues were used. However, on two occasions, trees, and on one

occasion, a garden shed, were selected for the 15- to 20-metre trials, as no other barriers were available. The researcher marked the locations on a small diagram before the trials began. An example from Participant 13 is shown in Figure 8.1. In the far/barrier trials, the L/V was always near to the barrier, with the C&R at a distance.

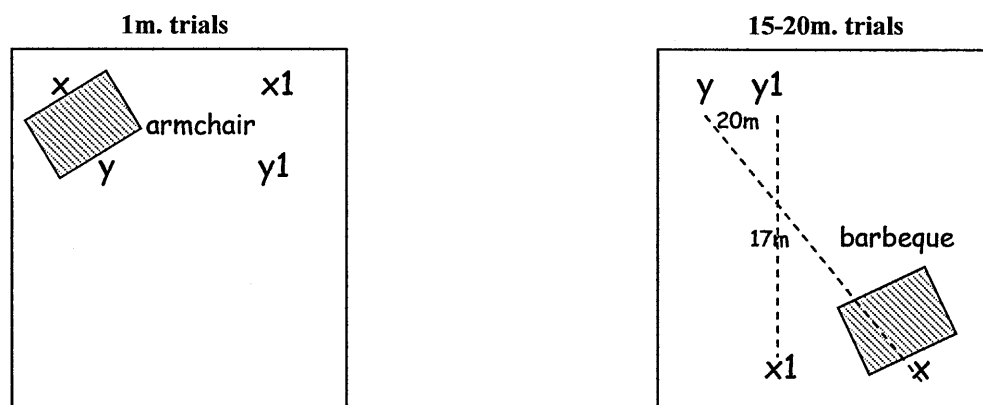


Figure 8.1. Diagrams showing locations in the Understanding Hearing and Understanding Vision tasks for Participant 13 (not to scale)

Key:

x = L/V in Trial 4	x = L/V in Trial 8
y = C&R in Trial 4	y = C&R in Trial 8
x1 = L/V in Trials 1, 2, 3	x1 = L/V in Trials 5, 6, 7
y1 = C&R in Trials 1, 2, 3	y1 = C&R in Trials 5, 6, 7

The child and the researcher spent a short time chatting in order for the child to be put at ease. When the researcher judged that the child was comfortable and relaxed, she explained that she and the child, along with another person were going to play some seeing and listening games. The researcher familiarised the child with all the locations before any trials began, taking particular care to ensure that the blind children understood exactly where each location was, saying, for example, “Now we’re in the hall, next to the piano. Do you know where that is?”

Once the researcher judged that the child was familiar with the locations, she introduced either the Understanding Hearing or Understanding Vision task, depending upon which order the tasks were to be administered to the child (see Appendix 4 for full instructions). The sequence described below is an example when the

Understanding Hearing task was first, but obviously, the Understanding Vision task came first for half of the participants.

The researcher talked to the child about hearing and listening, asking about quiet and loud sounds etc., to ascertain that the child understood what 'hearing' meant. The researcher showed the child the bell, and allowed her/him to play with it for a couple of minutes. Then the researcher told the child that they were going to play a 'listening' game, and that they were going to try to say whether the L/V, for example 'David', could hear the bell from different places in the house or school. In order to aid the children in their responses, and to eliminate the need for a verbal response, the children were asked to hold up ('Show') the pair of false ears from the Mr Potato Head toy if they thought the L/V could hear the bell, and to hold the ears behind their own back ('Hide') if they did not think that the L/V could hear the bell. The researcher demonstrated this and then four simple training trials were administered, to check that the child understood the procedure, and could make the appropriate responses. The researcher asked, "*What do you do if [L/V] can't hear the bell?*" and "*What do you do if [L/V] can hear it?*" These questions were repeated twice, and corrective feedback was given where necessary.

Once the researcher was confident that the child understood how to respond, she asked the L/V to move to each location in turn, and moved with the child to their corresponding position. All the locations were given a verbal label and the positions of the C&R and the L/V were described verbally (e.g. "We are standing here, behind the barbeque, and David is over by the washing line, facing towards us") to ensure that the child fully understood the position of him/herself in relation to the L/V. Then

the researcher rang the bell and said, *“Do you think that [L/V] can hear the bell or not?”* (prediction question). Depending on the response, the researcher then asked, *“Why do you think that [L/V] can/can’t hear the bell?”* (explanation question). This procedure was repeated for the remaining seven trials.

Understanding Vision

When the Understanding Hearing trials were completed, the researcher talked to the child about seeing and looking, to ascertain that the child understood what ‘seeing’ meant. She then showed the child the detachable eyes from the Mr Potato Head toy, explaining that hold the eyes close to his/her own head if he/she thought the C&R could be seen by the L/V, or hide the eyes behind his/her own back if he/she thought that they were not visible to the L/V. Again, the trials were preceded by four simple training trials to check that the child understood the procedure. The researcher asked, *“What do you do if [L/V] can’t see us?”* and *“What do you do if [L/V] can see us?”* These questions were repeated twice, and corrective feedback was given where necessary.

The Understanding Vision task was administered in the same way as the Understanding Hearing task, with the questions modified appropriately, for example, *“Mummy is on the patio turned away from us. Do you think she can see us or not?”* (prediction question). Depending on the response, the researcher then asked the child *“Why do you think that [L/V] can/can’t see us?”* (explanation question). This procedure was repeated for the remaining seven trials.

Correct responses to each of the trials in the Understanding Hearing and Understanding Vision tasks are shown in Table 8.2.

Table 8.2: Correct responses in the Understanding Hearing and Understanding Vision tasks

Trial	Code	Understanding Hearing	Understanding Vision
1	near/facing	can hear	can see
2	near/L/V away	can hear	cannot see
3	near/C&R away	can hear	can see
4	near/barrier/facing	can hear	cannot see
5	far/facing	cannot hear	can see
6	far/L/V away	cannot hear	cannot see
7	far/C&R away	cannot hear	can see
8	far/barrier/facing	cannot hear	cannot see

8.2.5. Scoring

Understanding Hearing task

Children received a score of zero to three points for each trial, based on responses to the prediction and explanation questions. Answers to the explanation question were classified into five categories, shown in Table 8.3.

Table 8.3: Response categories for the Understanding Hearing task

Category	Definition
a	Distance e.g. "She's close enough to hear it"
b	Sound level, e.g. "It's not loud enough"
c	Vision related: barrier, e.g. "The chair is in the way" orientation, e.g. "She's turned the wrong way" looking at/seeing, e.g. "She's/I'm not looking"
d	Irrelevant information, e.g. "She likes bells"
e	Don't know/no answer/he/she just can

Explanations from categories a) and b) were classified as correct explanations, indicating an understanding of the rules that govern hearing, whilst answers in the other categories were classified as incorrect. A correct prediction with a correct explanation was awarded three points. So for example, in the far/barrier trial, a response that the L/V could not hear, because she was too far away, or because the bell was too quiet, would score three points.

If a child gave a correct prediction, but gave an explanation from categories d) or e), then only one point was awarded, because the knowledge was considered to be implicit, but not yet explicit or procedural. An example, again from the far/barrier trial, would be that the bell could not be heard because the L/V “doesn’t like bells”.

When an incorrect prediction was accompanied by an appropriate explanation from category a) or b), a score of .5 was given. Children responding in this way were demonstrating that they were aware of the rules that influence hearing, but were under- or over-estimating their effect. A typical example from the far/barrier trial would be that the L/V could hear the bell because “she’s near enough to hear it”.

If a child gave a correct prediction with an incorrect explanation from category c), no points were awarded, because it was assumed that the prediction was correct for the wrong reason, and the child was not demonstrating an understanding of the rules that govern hearing. For example, in the far/barrier trial, a response that the L/V could not hear the bell because “the settee’s in the way” gained no points.

An incorrect prediction with an inappropriate explanation obtained a score of zero, as did an incorrect prediction accompanied by an explanation from categories d) or e).

The scores across all eight trials in the Understanding Hearing task were pooled for each child to give an overall score giving a possible total score of 24 points.

Understanding Vision task

A score of zero to three points was awarded for each trial, based on responses to the prediction and explanation questions. Answers to the explanation question were classified into seven categories, shown in Table 8.4.

Table 8.4: Response categories for the Understanding Vision task

Category	Definition
a	Distance e.g. "We're close by her"
b	Barrier, e.g. "We're behind here"
c	Orientation, e.g. " Her back is facing us"
d	Other sense related, e.g. "The wind will carry vision"
e	Viewer not visible to child, e.g. "I can't see her"
f	Irrelevant information, e.g. "Because we're in the garden"
g	Don't know/no answer/she/he just can

Explanations in categories a), b) and c) were classified as correct, indicating an understanding of the rules that govern vision, whilst answers in the other categories were classified as incorrect. The scoring was based on the same rationale as the Understanding Hearing task, so all three points were awarded if the child said, for example, that he/she could not be seen in the far/barrier trial because the barrier was blocking the L/V's view.

If a correct prediction were made, but the explanation was from categories f) or g), then one point was given. An incorrect prediction accompanied by an appropriate explanation from category a), b) or c) gained a score of .5; a correct prediction with an incorrect explanation from categories d) or e) did not earn any points; and nor did an incorrect prediction with an inappropriate explanation.

The scores across the Understanding Vision trials were pooled for each child to give an overall score. Thus, a total of 24 points was available for the task.

8.3. Results

Since the data were not normally distributed, non-parametric tests were used. The data are, however, not ordinal and can be reasonably considered as interval, so the mean scores and standard deviations (see Table 8.5.) will be reported rather than the range and median. For more detailed information, individual scores for the blind children can be found in Appendix 11.

Table 8.5: Mean score and S.D. in the Understanding Hearing and Understanding Vision tasks for the blind and sighted groups

Visual status	Understanding Hearing		Understanding Vision	
	Mean (max. 24)	SD	Mean (max. 24)	SD
Sighted (n = 30)	13.73	6.57	20.23	4.58
Blind (n = 8)	16.44	8.54	16.06	6.82

Mann-Whitney U tests showed that the sighted children performed significantly better on the Understanding Vision task than did the blind children ($U = 75.50, N_1 = 30, N_2 = 8, p = <0.05$, one-tailed) supporting the first hypothesis, which stated that sighted children would perform better than blind children on visual perspective-taking tasks that explored the effects upon vision of distance, occlusion, and orientation of both the viewer and the viewed. The difference in scores on the Understanding Hearing task did not reach significance ($U = 84.50, N_1 = 30, N_2 = 8, p = 0.101$, one-tailed), so the hypothesis that blind children would be more skilled than their sighted peers at predicting what another person can hear was rejected.

There were significant positive correlations between performance on the Understanding Vision task and age in both groups (Spearman $r = 0.587, n = 30, p = <0.01$ and Spearman $r = 0.933, n = 8, p = <0.01$, for the sighted and blind children respectively). Correlations between scores and age were weak and did not reach significance on the Understanding Hearing task however (Spearman $r = 0.274, n = 30$,

$p = >0.05$ and Spearman $r = 0.466$, $n = 8$, $p = >0.05$ for the sighted and blind children respectively).

The sighted children's scores supported the hypothesis that sighted children would perform better on tasks that required them to take the visual perspective of another person than on tasks that required them to take the auditory perspective of another person (Wilcoxon, $z = -4.22$, $p = <0.001$ one-tailed).

Scores on the two tasks for the blind children, however, were very similar (Wilcoxon, $z = -0.17$, $p = 0.433$, one-tailed), and did not support the hypothesis that blind children would demonstrate greater understanding of the factors that govern hearing than of the factors that govern seeing.

To summarise, the results supported the hypotheses that the sighted children would perform better than the blind children on the Understanding Vision task and that sighted children would perform better on the Understanding Vision task than on the Understanding Hearing task. The third hypothesis, which stated that blind children would score at higher levels than their sighted peers on the Understanding Hearing task was rejected. The last hypothesis, which predicted that blind children would perform better on the task that explored their understanding of hearing than they would on the Understanding Vision task was also rejected. In the next stage of data analysis, the blind children's possible use of analogies to the auditory modality in the Understanding Vision Task was investigated.

8.3.1. Blind children’s possible use of analogies to the auditory modality in the Understanding Vision task

The current study also aimed to identify if the blind children made analogies to the auditory modality when trying to predict the visual experiences of another person, and in order to do this, the data were considered trial by trial. The blind children’s mean score and SD for each location in the Understanding Vision task can be seen in Table 8.6.

Table 8.6: Blind children’s mean scores and S.D. for each location in the Understanding Vision task

Position	Mean (max. 3)	SD	Position	Mean (max. 3)	SD
1. seeing/near/facing	2.38	1.19	5. seeing/far/facing	1.75	1.36
2. seeing/near/L/V away	2.06	1.32	6. seeing/far/L/V away	2.06	1.32
3. seeing/near/C&R away	2.44	1.05	7. seeing/far/C&R away	1.94	1.47
4. seeing/near/barrier/facing	1.56	1.55	8. seeing/far/barrier/facing	1.93	1.47
Total near (max. 12)	9.00	4.74	Total far (max. 12)	7.69	2.33

It is clear from the results that the manipulations in distance, barriers and orientation caused problems for the blind children. Trial 4, where a distance of one metre separated the C&R and L/V, and a barrier was between them, caused the most confusion ($M = 1.56$, $SD = 1.55$). Four out of the eight blind children believed that they could be seen behind the occluding object. Trials in the 15- to 20-metre distance were also problematic for the blind children ($M = 7.7$, $SD = 4.7$). The effects of distance were over-estimated and children thought that 15- to 20-metres was too far to allow vision, regardless of orientation or lack of occluding objects. This was consistent with other studies (e.g. Bigelow, 1988, 1992; Nock et al., 2003a, 2003b; Nock et al., 2004).

The justifications that the children gave to support their predictions of whether the L/V could see the C&R were examined in order to identify if the children were using

visual rules to inform their predictions. Although no statistical analyses were carried out on the children’s justifications, there was some evidence to suggest that the blind children may have been using their experiences of the auditory modality to make predictions about whether they could be seen by the L/V in the Understanding Vision task. There were 64 response opportunities across the eight blind children, and a total of 14 (22%) of those responses were possibly based on auditory rules (Table 8.7.).

Table 8.7: Blind children’s erroneous justifications in the Understanding Vision task

Trial	No. of erroneous justifications	Example	Child's age
1 near/facing	0		
2 near/L/V away	1	'She's near us so she can definitely see us'	5;10
3 near/C&R away	0		
4 near/barrier	4	'She's near us.'	5;10
		'She'll see round it.'	7;6
		'There's a great big gap here ... he'll see in the gap.'	7;8
		'It doesn't meet the walls and ceiling so she can just see around the holes ... the space.'	8;11
5 far/facing	3	'Too far.'	5;10
		'Even though she's facing towards us, we're just too far away to see.'	7;1
		'Too far away.'	7;6
6 far/L/V away	2	'Too far away.'	5;10
		'He's not near enough.'	7;1
7 far/C&R away	2	'I can't hear her.'	7;1
		'The sight won't travel that far, even on the light.'	7.6
8 far/barrier	2	'Too far.'	5;10
		'The vision won't be big enough at this distance.'	7;6

Clearly, caution should be used when interpreting these comments, and it is by no means certain that they were directly related to auditory rules. However, in some situations, for example when there was an occluding object between the C&R and the L/V and they were separated by a distance of one metre, touch was not possible so it would seem that the judgements were likely to be made through reference to auditory rules, or by ‘boot-strapping’ the rules of audition on to visual rules. On the other hand,

where the L/V is turned away from the C&R at the same distance, touch was possible so the reasoning here is not so transparent. Some further examination of this possible 'boot-strapping' follows in the discussion.

8.3.2. Evidence of blind children's accurate understanding of vision

The focus up to this point has been upon the misunderstandings of the blind children. However, the blind children in Study 2 demonstrated that their knowledge of vision was surprisingly good, considering that they had no first-hand experience of it. Comments such as "The piano hid us" (7;6), "You can't see round big things" (7;1), "There's no eyes in the back of his head, you know!" (7;8), "She can only see the screen, but not us 'cos we're behind it." (9;3) and "She's facing the wrong way" (8;11), demonstrated complex knowledge about occlusion and orientation. Overall, there were 40 (62.5%) correct explanations of why vision was or was not possible from the various positions, compared to 24 (37.5%) erroneous explanations.

8.4 Discussion

The purpose of Study 2 was to investigate the ability of blind and sighted children to take the auditory and visual perspectives of another person. It was predicted that sighted children would perform better than blind children on visual perspective-taking tasks that explored the effects upon vision of distance, occlusion, and orientation of both the viewer and the viewed, and the results supported that hypothesis. It was also hypothesised that sighted children would demonstrate better understanding of the factors that govern vision than they would of the factors that govern hearing, and this hypothesis too was supported. It was expected that blind children would be more skilled than their sighted peers at predicting what another person can hear, but this

difference was not significant, and nor was their understanding of hearing significantly better than their understanding of vision, as had been predicted by the fourth hypothesis.

The effects of barriers and distance on vision were difficult for the blind children to predict, and at times, it is possible that they were using the rules of auditory perception to make judgements about whether they could be seen or not. Four out of the eight blind children believed that they could be seen behind an occluding object when separated from the viewer by a one-metre distance. Thus, one blind child aged 7;6 believed that she could be seen when she was behind a gymnastic vault. When asked why she thought that she could be seen, she replied, "Because she'll see round it ... look, like this" and proceeded to trace the path that she thought the line of vision followed with her hand. Similarly, another seven-year-old kept referring to the "... great big gap" at the side of the settee behind which she was hidden, claiming that her brother could "...see in the gap". One boy aged 8;11 believed that if the barrier didn't meet the walls and ceiling, then the viewer could see round the "holes". Several of the children said that they could be seen when behind the barrier at a distance of one-metre but not in the 15- to 20-metre position. Interestingly though, the youngest blind child, a boy aged three-and-a-half, gained all three points for Trial 4, stating correctly that he could not be seen, and explaining this by saying 'Because she's behind the chair and we're on the other side of it.' This was the only trial from both the Hearing and Vision tasks, in which he gave a justification for his response, and in all the others, he refused to answer the question.

In line with other studies, (e.g. Bigelow, 1988, 1992; Nock et al., 2003a, 2003b; Nock et al., 2004) the blind children over-estimated the effects on vision of distance, regardless of the viewer's orientation or the absence of barriers, and only 64 per cent of responses at a distance of 15- to 20-metres were correct. For example, one child aged 7;6 said, "Even though she's facing towards us, we're too far away to see anyway". Another, aged 5;10 believed that she could never be seen at the 15- to 20-metre distance, but was always visible in the one-metre trials. Her justifications were always related to proximity, for example, "He's near enough/too far away to see me". When asked if there were other reasons why she could not be seen in the 15- to 20-metre trials, she always responded, "No, he's just too far away."

It could be argued that the examples shown in Table 8.7. are not analogies to audition but simply misunderstandings about vision, for example, the seven-year-old who always related her explanations of why she thought she was or was not visible to proximity between herself and the viewer. However, some of the responses that the children gave were quite technical in nature, suggesting that they had gained some formal scientific knowledge about vision but were unable to apply it accurately, and were erroneously supplementing what they knew about vision with information that applied to audition. One girl aged 7;6 said that in Trial 7, where she was facing away from the viewer, she could not be seen by him because, "The sight won't travel that far, even on the light." Another child the same age said that she was not visible to the viewer in Trial 8, where the viewer was behind some large cardboard boxes because, "The vision won't be big enough at this distance." She made no reference to the occluding objects when asked if anything else was preventing her from being seen. It is possible that these two opinions were constructed by 'bootstrapping' auditory rules

on to the rules of vision. In the case of the first: “The sight won’t travel that far, even on the light”, an analogy to sound travelling on wind is possible. In the case of the second: “The vision won’t be big enough at this distance”, big is possibly related to loudness in auditory terms. An interesting focus for future research would be further exploration of blind children’s use of spontaneous analogies to other sensory modalities when carrying out visual perspective-taking tasks.

The blind children frequently revealed that although they could correctly predict that they were visible to the viewer, they had a number of flawed ideas about how vision might be distorted, particularly by distance, and many of their spontaneous comments are worthy of note. One child aged 9;5 correctly said that he could be seen at a 15- to 20-metre distance while facing away from the viewer. He added, again correctly, that the viewer would only be able to see his back, but then said, “He won’t be able to see the colours of my uniform though, ‘cos he’s too far away to see colours now.” When asked, he said that colours can only be seen “close up, like really near” and indicated an arm’s reach distance. He could not explain why this was so. Another example is that of a child aged 8;11 who said that he could be seen by the viewer at 15- to 20-metres while the viewer was facing towards him, but “She won’t see me clearly though, some bits will be missing ... like she can’t catch it all ... some will be blurred. She can see my head ‘cos that’s high up.” Similarly, a child aged 7;8 predicted that she could be seen from 15- to 20-metres when the viewer was facing towards her and there were no occluding objects, but added that “He’ll see the shape of me ... but he won’t be able to tell my face”. When asked what she meant, she responded, “He won’t be able to recognise my face, but if I shout to him he’ll recognise my voice.”

The sighted children were mainly correct in their predictions, although many of the three- and four-year-olds experienced confusion on tasks in which they were oriented away from the viewer. In this position, many of them believed that they could not be seen, but as discussed in Chapter Two, there is some evidence that at least a rudimentary understanding of the minds of others is a precursor to perspective-taking skills (McGuigan & Doherty, 2002), and thus it is feasible that the errors of the young sighted children were more closely related to an immature theory of mind than a lack of understanding about vision.

Notwithstanding this possibility, it was clear that some of the sighted children were confused about connections between modalities and the acquisition of sensory information. Some children made references to hearing when asked to explain why they thought that they could or could not be seen. For instance, when the viewer was oriented away from the child at the 15- to 20-metre distance, a four-year-old child correctly predicted that she could not be seen by the viewer, but when asked why this was so, she whispered, "She can't hear me whispering, so she won't be able to see me". It may be misleading then, to equate this type of reasoning only with blind children as Bigelow (1991b) seems to have done.

As has been discussed previously, there is plenty of evidence to suggest that cross-modality analogies are used by sighted as well as blind children. On the basis of research with infants, it seems that information from the visual, auditory and tactual modalities are coordinated very early on in life, and that infants perceive unitary objects by detecting amodal properties (Spelke, 1987). Young infants have an implicit awareness of intermodal equivalences and striking demonstrations of cross-modal

connections between vision and touch (Meltzoff & Borton, 1979), and vision and audition (Spelke, 1976), have been observed. It is unsurprising then that young children may find it difficult to discriminate between types of modality-specific information, or that they may apply rules about one modality to another modality. This phenomenon was also demonstrated in the earlier investigation of knowledge about aspectuality (Chapter Seven), where the responses of many sighted young children suggested that they were unsure about how specific types of sensory information were gained, failed to differentiate the types of information that can and cannot be gained through vision and tended to overestimate the roles of vision and touch in the acquisition of sensory information.

In summary, the present study explored blind and sighted children's ability to take the auditory and visual perspectives of another person. Their understanding of how distance, occluding objects and the orientation of the viewer and viewed affect vision was investigated. Four hypotheses were tested. The results supported the predictions that sighted children would perform better than blind children on the visual perspective-taking tasks and that sighted children would demonstrate better understanding of the factors that govern vision than they would of the factors that govern hearing. However, the prediction that blind children would be more skilled than their sighted peers at predicting what another person can hear was not supported. Nor was the hypothesis that blind children's understanding of hearing would be significantly better than their understanding of vision. In fact their knowledge of the two modalities was equally sophisticated.

A number of noteworthy findings emerged from the data. Although the blind children's performance on the task that explored their understanding of vision was not as sophisticated as that of their sighted peers, the blind children in the study demonstrated very good understanding of vision, and a number of comments that they made when asked to explain why they believed they could or could not be seen suggested that they understood some of the effects of distance, occlusion and orientation. There were misunderstandings, however, and predicting the effects of distance presented problems for many of the blind children. Generally, they tended to believe that a viewer would be unable to see across a 15- to 20-metre distance, and many of them equated proximity with vision, predicting that they could be seen by another person, regardless of orientation or occluding objects, providing they were separated only by a distance of one metre. These findings are consistent with those of previous researchers (e.g. Bigelow, 1988, 1991a, 1991b, 1992; Landau & Gleitman, 1985), and are arguably more generalisable because they are drawn from a larger sample than was used in previous studies. It was suggested that at times, there was some evidence that the blind children may have been making spontaneous analogies to the auditory modality when carrying out visual perspective-taking tasks.

Blind and sighted children's understanding of the parameters of distance (Bigelow, 1988, 1991a; Hughes & Donaldson, 1979) and orientation (e.g. Masangkay et al., 1974; Miletic, 1995) have been explored in earlier studies. However, the research to date has been shaped by adult understanding of the factors that affect vision, without consideration of the beliefs and opinions of children about what factors facilitate or inhibit vision. The following two studies attempted to address this issue, by exploring sighted and blind children's opinions about the factors that affect visual access, and

sought to investigate not only what they understand about vision, but also, what information they use to make predictions about what others see.

BLIND CHILDREN'S UNDERSTANDING OF VISION

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CHAPTER NINE

STUDY 3: BLIND AND SIGHTED CHILDREN'S BELIEFS ABOUT FACTORS THAT AFFECT VISION

9.1. Introduction

Having considered blind and sighted children's knowledge about each sensory modality, and having explored their abilities to take the visual and auditory perspectives of another person, the remaining studies will focus specifically on understanding of the visual modality.

A key finding to emerge from the previous study was that sighted children were more accurate than blind children in their predictions about how the parameters of distance, barriers and orientation affect the visual experience of another person. However, although blind children's knowledge was not as comprehensive as that of their sighted peers, the blind children in Study 2 demonstrated competent understanding of vision. Their responses to questions and also their incidental comments provided some evidence that they all understood something of the effects of distance, barriers and orientation upon vision.

The current study aimed to investigate blind and sighted children's beliefs about the importance of various physical factors that affect vision. It tested the hypothesis that there would be differences in the beliefs of blind and sighted children about which factors are most and least important for vision. This was based upon the findings of the previous study that blind children do not perform as well as their sighted peers on visual perspective-taking tasks exploring the effects of distance, barriers and orientation upon vision, and other similar findings, suggesting that they do not attach

the same level of importance to some of the physical factors that affect vision as do their sighted peers (e.g. Bigelow, 1991a, 1991b, 1992; Nock et al., 2003a; Nock et al., 2004).

The research to date has been shaped by adult understanding of the factors that affect vision without consideration of the beliefs of children about what factors facilitate or inhibit vision (e.g. Bigelow, 1988, 1991a, 1991b, 1992; Boydell et al., 2003; Dunphy-Lelii & Wellman, 2004; Flavell, 1978; Flavell et al., 1981; Flavell, Flavell et al., 1980; Flavell et al., 1991; Flavell et al., 1978; Flavell, Shipstead et al., 1980; Hughes & Donaldson, 1979; Masangkay et al., 1974; Miletic, 1995; Nock et al., 2003a, 2003b; Nock et al., 2004). Furthermore, the research has been largely quantitative in nature. The current study incorporated a number of methodological advances in order to appreciate better what blind and sighted children understand about the factors that affect the visual experience of sighted people.

The methodology used to investigate blind and sighted children's beliefs about vision was based on a model proposed by Thomas and O'Kane (2000), who suggest that there is no hard and fast distinction between qualitative and quantitative approaches, and that theory can emerge from data, but not without being affected by the suppositions and predilections of the researcher. Thomas and O'Kane (2000) suggest that one way to combine qualitative and quantitative methods is to:

... begin with a survey, in order to map out the terrain and identify salient features, which are then explored further in ways that incorporate the meaning of phenomena to those involved. (Thomas & O'Kane, 2000, p.820).

In line with this notion, the current study incorporated and built upon what children *themselves* believe about vision, by employing a three-stage research process. In the

first stage, as suggested by Thomas and O’Kane (2000) an initial survey of children’s opinions about the factors that affect visual experience was carried out. At this stage, the opinions of adults were also sought. This was for the purpose of comparison with the opinions of children, and to investigate whether adults and older children included reference to psychological factors that affect vision, demonstrating Level 3 perspective-taking (Flavell, 1978). Second, the data from the survey were used to ‘identify salient features’ (Thomas & O’Kane, 2000, p.820). which were then incorporated into a questionnaire, the purpose of which was to identify the factors most frequently chosen. In the Thomas and O’Kane task, children were asked to rank nine factors terms of their importance (in their case, on a variety of subjects, for example, the most important qualities that dinner ladies should possess). The children ranked the factors in a diamond shape, with the most important one at the top of the diamond, then the two next most important factors, then the middle three, the lower two and finally, at the bottom, the least important factor. The relevance of the diamond shape is that it essentially gives a 1 - 2 - 3 - 2 - 1 ranking whereby the middle order statements can have some sort of parity, which is not possible with ordinal ranking, and allows the children to judge some factors as being of equal importance. Thus, in this current study, the questionnaire data was used to identify the nine factors most frequently chosen as important for vision and these nine factors were then used to construct an adapted version of the interactive ranking task designed by Thomas and O’Kane (1998). The three stages are reported separately in order to show clearly how the final task emerged from the previous stages.

The problems associated with recruiting congenitally blind children without additional impairments in the UK was reported in Section 6.3.2. Because of this shortage of

available blind participants, a decision was taken to carry out the first two stages of the study, when information was being gathered for the development of the final task, with sighted participants only, rather than divide the available blind children who met the research criteria across the three stages of the study. This allowed for the inclusion of all the available blind children at the third stage, when a comparison of the opinions of blind and sighted children was made.

9.2. Stage 1: Initial survey of the opinions of sighted children and adults about the factors that affect visual experience

9.2.1. Method

9.2.1.1. Participants

Ten sighted adults and 40 sighted children took part in this stage of the study. The adults ranged in age from late teens to just prior to retirement. They were predominantly White British, but some participants were of Asian or Afro-Caribbean ethnicity and they were drawn from a number of occupational backgrounds, including students, lecturers, factory workers, sign writers and nurses. They were selected on the basis of being available to the researcher, either professionally or through personal contacts. The participants were given an information sheet, which gave details about the research and explained what participation would involve. They were asked to sign a consent form after they had been given time to consider their decision, and were informed that they could withdraw from the research at any time. They were also assured that should they so wish, any data that they provided would be destroyed and that there would be no resultant adverse consequences (HPMEC, 2006, pp.1-2).

The children were recruited from two primary schools in the West Midlands. A letter was sent to all families of children in the target age-group, informing them that the researcher would be in school on a specified date collecting data from various tasks and that if they did not want their child to participate they should opt out by completing a tear-off slip at the bottom of the letter (see Appendix 2C). This was at the request of the Headteachers of the schools involved, and was acceptable to the researcher, as ethical guidelines state that consent can be gained from those acting *in loco parentis* (HPMEC, 2006, p.1). In the event, no sighted children's families opted out. The catchment area of one school was largely middle-class, whilst the other was predominantly working-class. The children ranged in age from 4;6 to 11;5 ($M = 97.03$ months, $SD = 24.58$ months), and they were mainly White British, but with some participants being of Asian or Afro-Caribbean ethnicity.

9.2.1.2. Design

A survey of children's and adult's opinions about the factors that affect visual experience was carried out.

9.2.1.3. Procedure and materials

The participants were given a sheet of blank A4 paper and a pencil and were asked individually to list as many factors as they could that affect vision. The researcher said, *"Write down (or tell me in the case of young children, who were not confident writers) all the things that you can think of that make a difference to how well we see things. Anything that you can think of that affects whether objects can be seen or not, or how clearly they can be seen. They can be things that make seeing better or more difficult."* If a participant asked for clarification, the researcher said *"Well, light*

affects how well we see, doesn't it? If it's dark, I can't see, and even when my eyes get used to the dark, nothing is clear. So light would be on my list.” In the event, only two adults and five children asked for clarification. Occasionally, participants gave their own example in order to gain clarification, for instance, one adult participant said, “Do you mean like, if I put on glasses, or if I'm a long way away, that'll make a difference to how clear things look, or how much detail I can see?” Similarly, a seven-year-old child asked, “Like, I'm not big enough to see over walls and stuff, so do I write ‘how tall you are’ for one of my things?” In such cases, the researcher assured the participants that they were on the right track. Participants were also assured that there were no right or wrong answers; their own opinion was what was being sought.

9.2.2. Results

The adults produced a range of four to nine factors ($M = 7.3$, $SD = 1.8$) and the children between one and 15 factors ($M = 7.45$, $SD = 3.88$). The identified factors were organised into thematic domains. Because the aim at this initial stage of the study was to discover which factors would be identified by sighted adults and children, exact quantitative measures were not noted, and each factor identified was included, with none being discounted or devalued on the grounds of being unrepresentative.

Some of the participants' responses were clear and straightforward to categorise, for example the following statements were grouped together in the ‘Eyes open’ category: ‘Having your eyes open’; ‘Not closing your eyes’. Others were more complex: ‘Well, if a ball's moving really quickly, like in tennis, it's hard to track its movement’; ‘If things are still or moving quite slowly you can see them clearly, but fast-moving

things sometimes look a bit blurry'. These were categorised as 'Movement of object'. Although factors such as corners, curves, angles or straight lines of sight could theoretically have been organised into one category called 'Angle', 'Corners' and 'Curves' were retained as discrete factors. This was because some studies (e.g. Boydell et al., 2003; Flavell et al., 1991) have suggested that young children underestimate the effects of curves (for example when looking through a curved tube) when predicting visibility, while they are much better at predicting the effects of corners – what might be termed as clear or obvious angles (for example, looking through a tube bent at a 90° angle). Answers relating to straight lines of sight or angle of vision were categorised as 'Angle'. This process resulted in the identification of 28 factors, which were used in Stage 2 of the study (see Table 9.1). In order to ensure the reliability of the researcher's allocation of factors to categories, 25 per cent of the responses were independently categorised by another rater. Inter-rater agreement, calculated by dividing the number of identical allocations by the total number of allocations, was .98.

Table 9.1: The 28 factors identified by children and adults as having an effect upon vision

Factor	Identified by		Factor	Identified by	
	Children	Adults		Children	Adults
Tiredness	Yes	Yes	Illness	No	Yes
Colour	Yes	Yes	Alcohol/drugs	No	Yes
Preconceived expectations	No	Yes	Movement of object	Yes	Yes
Smells	Yes	Yes	Vision aids (e.g. glasses, microscope)	Yes	Yes
Barriers	Yes	Yes	Angle	Yes	Yes
Size of object	Yes	No	Eyes open	Yes	Yes
Light	Yes	Yes	Thinking about other things	Yes	Yes
Height of viewer	Yes	Yes	Healthiness of eyes	Yes	Yes
Noise	Yes	Yes	Age	Yes	Yes
Using one eye only	Yes	No	Distractions	Yes	Yes
Curves (bends)	Yes	Yes	Mood	No	Yes
Weather	No	Yes	Corners	Yes	Yes
Facing towards the object	Yes	Yes	Transparency	Yes	Yes
Distance	Yes	Yes	Viewer movement	Yes	Yes

The survey produced data that suggested that adults and children share some views about the physical factors that affect vision, and both children and adults identified factors such as light, barriers and eyes open. Also, both children and adults made statements about the effects of noise and smell on vision.

Younger children tended to name physical factors, such as eyes open, presence of occluding barriers etc., rather than psychological factors, for example mood, past experience, that influence vision. Responses from older children, and particularly adults, included reference to the psychological factors than can affect vision, such as

tiredness, distractions, thinking about other things. No child below the age of ten years suggested these factors. Only adults referred to mood, and preconceived expectations.

9.2.3. Discussion

It has been suggested in this thesis that to date, research into the development of perspective-taking ability has been shaped by mature adult understanding about the range and limits of vision, with scant regard for children's views and opinions. The data from the survey suggested that some factors, particularly physical ones, such as eyes open, light and distance, are considered to affect vision by both adults and children from four to 11 years of age. However, thinking about other things, tiredness and distractions, which are psychological factors, were never mentioned by children younger than ten years. Preconceived expectations and mood were not cited by any child as having an effect on vision. This response pattern is in line with Flavell's (1978) theory that Level 3 understanding of perspective-taking, which includes reflective and abstract knowledge about visual perception, such as the influence of past experience or mood emerges at around ten to 11 years of age (see Section 4.2.1.).

Interestingly, adults as well as children named smell and noise as factors that influence vision. The researcher asked for explanations if none was given spontaneously, and participants responded in a number of ways. For example, one six-year-old said, "When a thing's making a noise, you can see it more clearly", suggesting a confusion about modality-specific information (O'Neill & Chong, 2001). One adult said, "If you're looking one way and then you hear a noise, then you look towards the noise and you see the thing, don't you ... but you wouldn't have seen it if

you didn't look". This suggests that the participant may have been focused more on attention than noise, or even on orientation towards the target object. Another adult simply wrote, "Sound – drowning senses". One ten-year-old said, "When I'm looking, like at Miss (*the teacher*), and somebody makes a noise outside the classroom, it distracts me so that I don't see Miss properly then, so it makes a difference to my seeing". Again, this could be related to attention and orientation more than the noise itself. Similar comments were made about smells, for example: "Gel pens smell so their colours look brighter than ordinary pens" (six-year-old); "The smell of onions makes your eyes run so things look blurred" (adult).

There were many noteworthy comments, and these are only a few, but further research could explore this in more depth, perhaps by classification of responses into groups that could be identified as 1) inability to discriminate between types of sensory information, 2) noise/smells as distractions, and 3) noise/smells as stimuli that attract attention.

In conclusion, there were factors that both children and adults considered to be important for vision, but some factors were particular to one group or the other. Children of 11 years and below tended to focus more on physical influences on vision, although there was evidence of the emergence of Level 3 perspective-taking (Flavell, 1978) in some children over the age of ten years. Adult responses contained reference to both physical and psychological factors.

The factors that were identified by the survey were then explored further, as recommended by Thomas and O'Kane (2000), in order to identify which of them

were considered by sighted children to be the most important. The factors were used to compile a questionnaire, from which it would be possible to identify the nine factors considered by children to be most important for vision.

9.3. Stage 2: Questionnaire

The opinions of adults were again sought at this stage in order to provide further supporting evidence for Level 3 perspective-taking (Flavell, 1978) in older children and adults.

9.3.1. Method

9.3.1.1. Participants

Twenty-five adults and 36 children, none of whom had participated in Stage 1 took part in Stage 2. All the participants were sighted. An opportunity sample of adults ranging in age from late teens to just before retirement age was recruited. They were predominantly White British, but some participants were of Asian or Afro-Caribbean ethnicity and they were drawn from number of occupational backgrounds, including students, lecturers, teachers, factory workers and nurses. They were selected on the basis of being available to the researcher, either professionally or through personal contacts. (Refer to Sections 6.3.2. and 9.2.1.1. for detailed information on recruitment and ethical considerations.)

The children were recruited from two primary schools in the West Midlands, the catchment area of one school was largely middle-class, whilst the other was predominantly working class. The children were aged between 7;6 and 11;5 ($M = 112.25$ months, $SD = 14.22$ months). They were divided into four age-groups: 7;6 to

8;5 ($M = 94$ months, $SD = 3.54$ months); 8;6 to 9;5 ($M = 106.33$ months, $SD = 4.27$ months); 9;6 to 10;5 ($M = 118.11$ months, $SD = 3.82$ months); and 10;6 to 11;5 months ($M = 130.56$ months, $SD = 3.05$ months). Children of seven-and-a-half years and above were recruited because the task required them to be able to read competently. They were mainly White British, but some were of Asian or Afro-Caribbean ethnicity. (Refer to Sections 6.3.2. and 9.2.1.1. for detailed information on recruitment and ethical considerations.)

9.3.1.2. Design

A questionnaire, which explored children's and adults' opinions about the importance of factors that affect vision was used.

9.3.1.3. Materials

In order to identify the nine factors considered to be most important for vision for use in the final stage of the study – the Ranking task, the 28 factors identified in Stage 1 were presented in a questionnaire, along with the following instructions:

Below is a list of 28 items that people think affect whether objects can be seen or not or how clearly they can be seen. Choose the nine things that you think are the most important for seeing and put a circle around each one. You don't need to put them in order of importance.

The questionnaires were presented on sheets of white A4 paper. The content of the questionnaires was identical for the children and the adults, except that adults were not asked to disclose age or gender. The font used for the children's questionnaire was Comic Sans MS, size 12, as this is a font that is commonly used in primary schools, and for the adult version, Times New Roman, size 12, was used (Appendix 5).

9.3.1.4. Procedure

The participants were asked to choose nine factors from the list that they considered to be the most important in determining whether objects can be seen or not, or how clearly they can be seen. They were not asked to rank the factors in order of importance. The participants completed the questionnaire individually.

The adults completed the questionnaire at their place of work or in their own homes. The researcher read aloud the instructions that appeared on the questionnaire, and clarified that all understood the task. In the event, all did.

The children completed the questionnaire at school. They were withdrawn from the classroom in small groups (usually of four) to minimise inconvenience to their teachers, and the instructions (see below) were read aloud by the researcher. When the researcher was sure that the children understood what was required, she sent them to complete the questionnaire at different tables, so that they would not be influenced by one another's responses. The task instructions were as follows: *"Today, we're going to play a game about seeing. You will have a sheet of paper with a list of things that affect how well you can see things. You have to choose nine of those things, the ones that you think are most important for seeing. I'll read the instructions to you in a minute, and before you start to choose your nine things, I'm going to sit you at different tables so that you can't see anyone else's sheet. It's really important that you don't talk to each other about what you're going to choose, because I want to know what each of you think. There are no right or wrong answers, whatever you think is what I want to know. So, even though it's a game, we'll do it like a test with no copying or talking. Does everyone understand?"* The researcher then read through the

whole questionnaire with the children and clarified the instructions as above, adding again that it was important not to talk to the other children about which factors they had chosen. She also clarified certain factors when asked. For example, all the children needed clarification of Factor 3, ‘preconceived expectations’. The researcher described this as *“What we expect to see, so for example, if somebody in your class often gets into trouble for fighting, if you saw him play wrestling with another child in the playground, you might think that he was really fighting, and tell the teacher. Because you often see that boy really fighting, it affects how you understand what he’s doing.”*

9.3.2. Results

The data from the questionnaires were collated, and the scores of the adults ($N = 25$) and the children ($N = 36$) were compared (see Figure 9.1).

Key to Figure 9.1:

- | | | |
|------------------------------|-------------------------------|---------------------------------|
| 1. Tiredness | 11. Curves (bends) | 20. Eyes open |
| 2. Colour | 12. Weather | 21. Thinking about other things |
| 3. Preconceived expectations | 13. Facing towards the object | 22. Healthiness of eyes |
| 4. Smells | 14. Distance | 23. Age |
| 5. Barriers | 15. Illness | 24. Distractions |
| 6. Size of object | 16. Alcohol/drugs | 25. Mood |
| 7. Light | 17. Movement of object | 26. Corners |
| 8. Height of viewer | 18. Vision aids | 27. Transparency |
| 9. Noise | 19. Angle | 28. Viewer movement |
| 10. Using one eye only | | |

Both groups were of the opinion that light (92% in each group) was very important. Distance (88% and 6 % for adults and children respectively), eyes open (68% and 94%), and healthiness of eyes (68% and 78%) were rated highly by both adults and children. Seventy-two per cent of the children selected vision aids (e.g. glasses, magnifying glasses, telescopes, microscopes), while only 16 per cent of adults included this factor. At the lower end of the scale, there was less consistency between

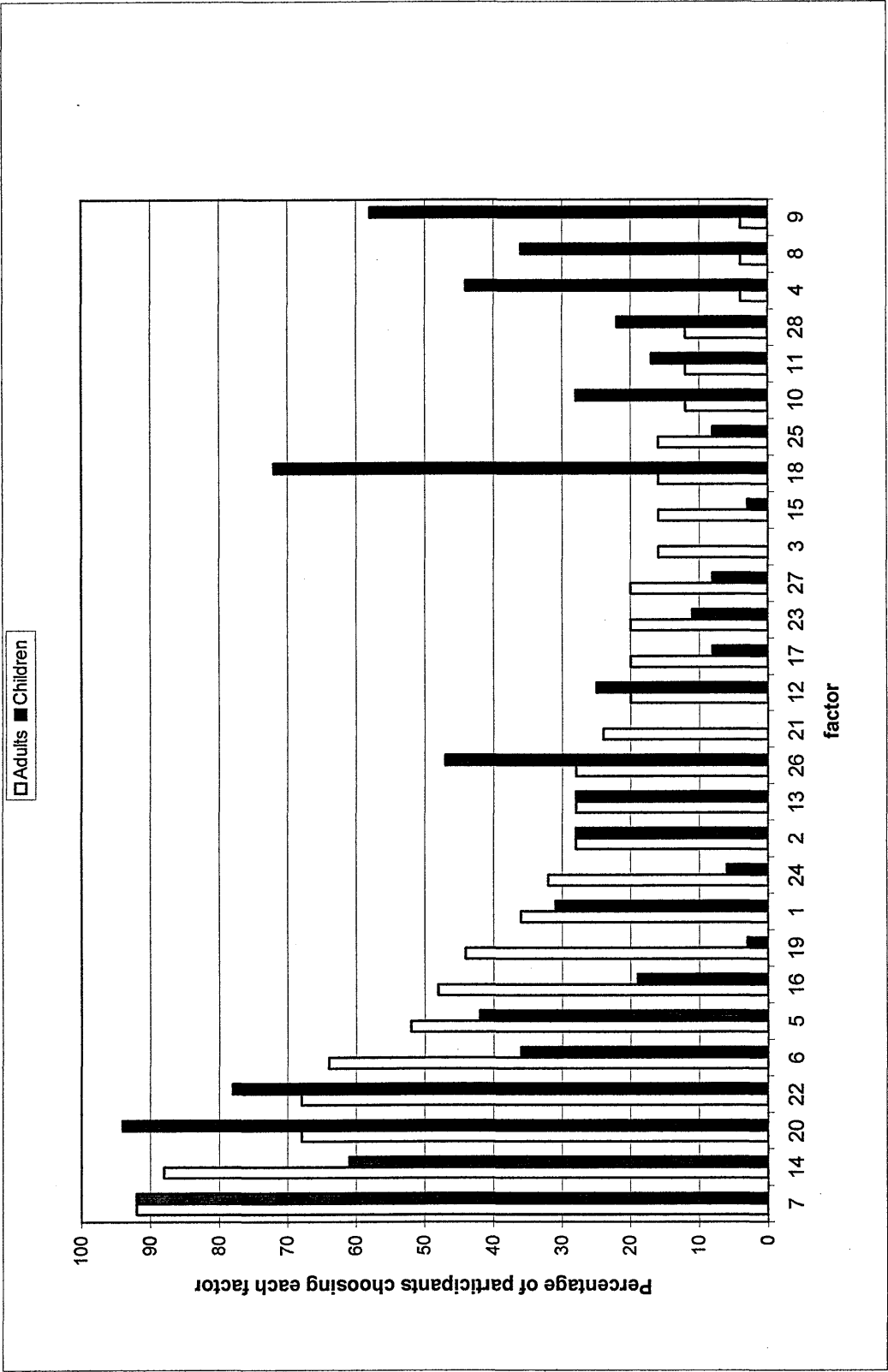


Figure 9.1: Percentage of children and adults selecting each of the 28 factors that had been identified as important for vision

the adults and children. Only four per cent of adults selected smells, height of viewer and noise as important for vision, while children cited these much more frequently.

None of the children selected preconceived expectations or thinking about other things, and just three per cent included illness and angle in their nine most important factors.

The nine factors considered most important for vision were identified for each group. These can be seen in Table 9.2.

Table 9.2: The nine most important factors for vision identified by the five groups					
Group	Factor	Percentage selecting factor	Group	Factor	Percentage selecting factor
7½-8½	Vision aids	100	8½-9½	Eyes open	100
	Eyes open	100		Light	89
	Health of eyes	89		Noise	89
	Light	78		Vision aids	89
	Barriers	67		Health of eyes	78
	Size of object	67		Distance	67
	Height of viewer	67		Corners	56
	Smells	67		Smells	44
	Noise	56		Barriers	33
9½-10½	Light	100	10½-11½	Light	100
	Distance	78		Eyes open	100
	Eyes open	78		Health of eyes	89
	Vision aids	67		Distance	67
	Tiredness	56		Tiredness	56
	Colour	56		Noise	44
	Alcohol/drugs	56		One eye	56
	Health of eyes	56		Corners	44
	Noise	56		Viewer movement	44
All children pooled	Eyes open	94	Adults	Light	92
	Light	92		Distance	88
	Health of eyes	78		Eyes open	68
	Vision aids	72		Health of eyes	68
	Distance	61		Size of object	64
	Noise	58		Barriers	52
	Corners	47		Alcohol/drugs	48
	Smells	44		Angle	44
	Barriers	42		Tiredness	36

Some factors were selected by all the groups. These were light, eyes open and health of eyes. Distance appeared in all except the youngest age-group, and noise was chosen by all the children's groups but not by the adults.

9.3.3. Discussion

It was notable that all groups identified light, open eyes and health of eyes as important for vision. When the data from the children (pooled) and the adults data were compared, these three factors appeared in the top five for both groups. Barriers were also selected by both groups.

The remaining five choices were more varied. Seventy-two per cent of the children selected vision aids such as glasses, magnifying glasses, telescopes, and microscopes (compared to only 16% of adults). This factor appeared in the top nine in the three youngest age-groups. This may be related to the fact that the science curriculum for this age-group requires the use of magnifying glasses and microscopes, and such equipment is usually a cause of excitement and wonder in children of this age. The factor did, however, cause confusion for some children, who were of the opinion that it could be the same as health of eyes, given that it included glasses. Some asked if contact lenses were included too, and one 11-year-old boy suggested that magnifying glasses, telescopes, binoculars and microscopes should be one factor, while glasses, contact lenses and monocles should form another.

It is unsurprising that alcohol and drugs were chosen by 48 per cent of adults, given that most adults have probably experienced the effects of one or both of these. The only children's group to select this category was the 9½- to 10½-year-olds, and again,

this could be because this age-group (Year 5) are taught about drugs and alcohol in the Personal, Social and Health Education (PSHE) curriculum, so the subject may have been particularly pertinent to them.

Overall, a large number of children included smells (44%) and noise (58%) in their nine most important factors, whilst only four per cent of adults chose these. It is difficult, without further investigation, to identify exactly what the children meant by these factors. In the initial survey both children and adults made statements about the effects of noise and smell on vision, and children identified this factor much more frequently (see Section 9.2.2.). Likewise, it is difficult to explain why children emphasise the effects of other modalities upon visual experience. The results from Study 1, in which sighted children aged between three and six years demonstrated confusion about modality-specific information, and Study 2, where both blind and sighted children possibly made cross-modality analogies when trying to predict the visual and auditory experiences of another person, also support the notion that there is a lack of explicit understanding about modality-specific information in young children. Children aged between nine and 11 years selected noise, but not smell, as one of the nine most important factors to affect vision.

9.4. Stage 3: Ranking task

9.4.1. Method

9.4.1.1. Participants

The participants were 50 sighted children aged between 8;0 and 12;11 ($M = 125.28$, $SD = 17.11$ months) and 12 congenitally blind children with no other physical or cognitive impairments aged between 7;11 and 14;8 ($M = 124.75$ months, $SD = 25.66$

months). The lower age limit was decided primarily by the need for the participants to be able to read competently, as the task required that they could do so. Two of the blind children were older than the oldest sighted children, but a decision was taken to include them in order to maximise the size of the blind group.

The sighted children were mainly White British, but some participants were of Asian, African or Afro-Caribbean ethnicity. They were recruited from two primary schools and two comprehensive schools in the West Midlands, with largely middle- and working-class catchment areas. They were selected upon the basis of their teacher identifying them as ‘competent readers’. (Refer to Sections 6.3.2. and 9.2.1.1. for detailed information on recruitment and ethical considerations.)

Nine of the blind children were White British and three were of African ethnicity, born in the UK. They came from a range of socio-economic backgrounds. Further characteristics can be seen in Table 9.3. The five youngest blind children participating in Stage 3 of the study had also taken part in Studies 1 and 2. They too were selected upon the basis of their teacher identifying them as ‘competent readers’ either of Class 1 or Class 2 Braille. (Refer to Section 6.3.2. for detailed information on recruitment and ethical considerations.)

Table 9.3: Characteristics of blind participants in the Ranking task

Child	Cause of blindness	Age	Gender	Level of vision	
				R	L
D	Optic Nerve Hypoplasia	7;11	f	LP	LP
O	Retinopathy of prematurity	7;11	f	LP	LP
C	Lebers amaurosis	8;2	f	none	none
A	Lebers amaurosis	8;11	m	none	none
Mo	Retinal dystrophy	9;6	m	low LP	Low LP
J	Retinopathy of prematurity	10;2	f	LP	LP
S	Lebers amaurosis	10;3	m	LP	none
E	Lebers amaurosis	11;0	m	none	none
Se	Anophthalmia	11;2	f	none	none
Be	Retinopathy of prematurity	11;8	m	none	none
Ma	Bilateral microphthalmus	13;5	m	none	none
Ad	Lebers amaurosis	14;8	m	LP	LP

9.4.1.2. Design

Because the present study aimed to explore children's own opinions about things that are important for vision, the factors selected by adults in the questionnaire were not used. It was initially planned to use the nine factors most frequently chosen by the children in the questionnaire stage when the data were pooled across all age-groups (see Table 9.2.). However, one modification was necessary: given that the vision aids factor had caused some confusion, it was not included in the task, and the next most popular children's choice, size of object, was selected instead. The nine factors then, were as follows: eyes open; light; distance; noise; corners; smells; barriers; size of object; health of eyes.

The nine factors were used to construct an adapted version of an interactive ranking task designed by Thomas and O'Kane (1998). The blind and sighted children were asked to rank the nine factors in a diamond shape, with the most important one at the top of the diamond, then the two next most important factors, then the middle three, the lower two and finally, at the bottom, the least important factor. Once they had

completed the Ranking task, the children were asked to explain why they had selected their three most important factors. It was intended that this would provide some insight into the children's rational when ranking the factors in order of importance.

9.4.1.3. Materials

A small, plastic, rectangular Guideway Letter and Figure Tablet Aligning Tray (available from Didax, Inc.), measuring 28cms x 15cms, with five horizontal grid lines, which could be distinguished tactually, was used as a frame upon which to place nine small laminated cards in the required diamond shape (see Figure 9.2).

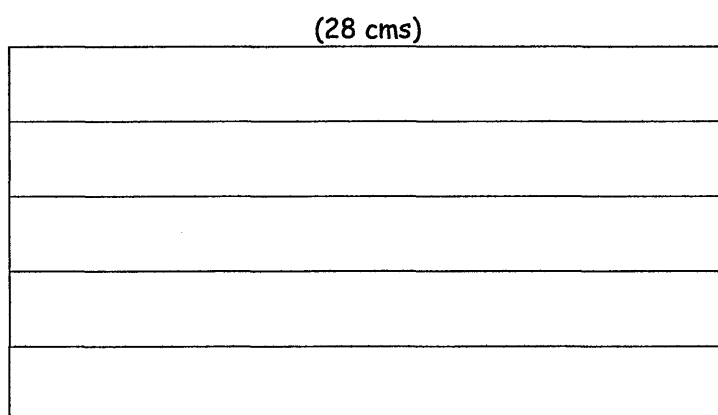


Figure 9.2. Line drawing of the Guideway Letter and Figure Tablet Aligning Tray used in the Ranking task

The following words/phrases (factors) were displayed, either in Comic Sans MS size 20 font (sighted children) or in Class 1 or 2 Braille (blind children) upon the nine small laminated cards: eyes open; light; distance; noise; corners; smells; barriers; size of object; health of eyes.

9.4.1.4. Procedure

The children were tested individually. The child and the researcher spent a short time chatting in order for the child to be put at ease. When the researcher judged that the child was comfortable and relaxed, she invited the child to sit with her at a table and

then said to the child *“Today, we’re going to play a game about things that are important for seeing.”* It is possible that the wording of this statement may have had a priming effect, in that the child may initially have thought that some of the given factors would not affect vision, but be influenced by the researcher’s use of the word ‘important’. However, this was mitigated in the subsequent statement, made as the researcher gave the child the Guideway Letter and Figure Tablet Aligning Tray and the nine small laminated cards: *“Here are nine cards with different words or phrases on them. Some other children told me that these things make a difference to how well sighted people can see. They might make seeing better or they might make it more difficult. They might make a difference to how clearly things can be seen.”* The blind children were encouraged to feel the tray and explore the dimensions and the demarcations between each level. The researcher then asked the child to read aloud from each card in turn, giving help as needed (although this was rarely necessary), and asked what each factor meant. Sometimes children referred to seeing in their explanations, and sometimes they simply described what they thought the factor meant. Occasionally, they pointed to an example of the factor, or demonstrated using hand gestures. All responses were accepted, provided that the child demonstrated a clear understanding of the meaning of each word or phrase. Typical responses for each factor are as follows:

Eyes open – “This is your eyes open ...like this” (demonstrates opening and closing own eyes), (blind child aged 7;11);

Light - “If there’s no light you won’t be able to see”, (sighted child aged 10;7);

Distance – “If it’s too far away, it’s, erm, faded, and you can’t see good” (sighted child aged 11;2);

Noise – “It’s when you can hear things like talking or banging” (blind child aged 8;2);

Corners – “This is a corner ... here on the table” (pointing to the right angle at the corner of a table) (sighted child aged 12;6);

Smells – “It’s ... like ... it goes up your nose, and sometimes it’s nasty or it can be nice ... like perfume, or like gel pens ... or food.” (sighted child aged 9;5);

Barriers – “Well, that would be something in between your eyes and the thing that was hidden. You can’t see *through* things ... unless they’re *transparent* ... like windows” (sighted child aged 8;10);

Size of object - “Some things are big, like an elephant or a massive truck, and some things are tiny ... microscopic ... germs and cells” (blind child aged 11;8);

Health of eyes – “Some people are blind. That means they can’t see anything and their eyes are *not* healthy, or sometimes you might get an eye infection, and your eyes get sore and you won’t see clearly ‘cos your eyes will keep watering and you’ll keep rubbing at them” (sighted child aged 8;0).

The children could usually provide clear definitions of all nine factors, but if a child was unsure of the meaning of a factor, or gave an inaccurate definition, the researcher clarified the meaning. For example, one eight-year-old sighted child was unable to define distance. The researcher explained that distance means how far away or how close something is, then asked the child to give an example of something that was a long distance away and something that was close.

The researcher demonstrated how the diamond should be constructed using blank cards, and explained that the most important factor should be placed at the top, then the next two factors, etc., with the least important factor at the bottom of the diamond shape. The blind children were invited to feel the grid with each new placement of the

researcher’s cards. The researcher then asked the child to arrange the nine cards in a diamond shape within the tray, as instructed (see Figure 9.3).

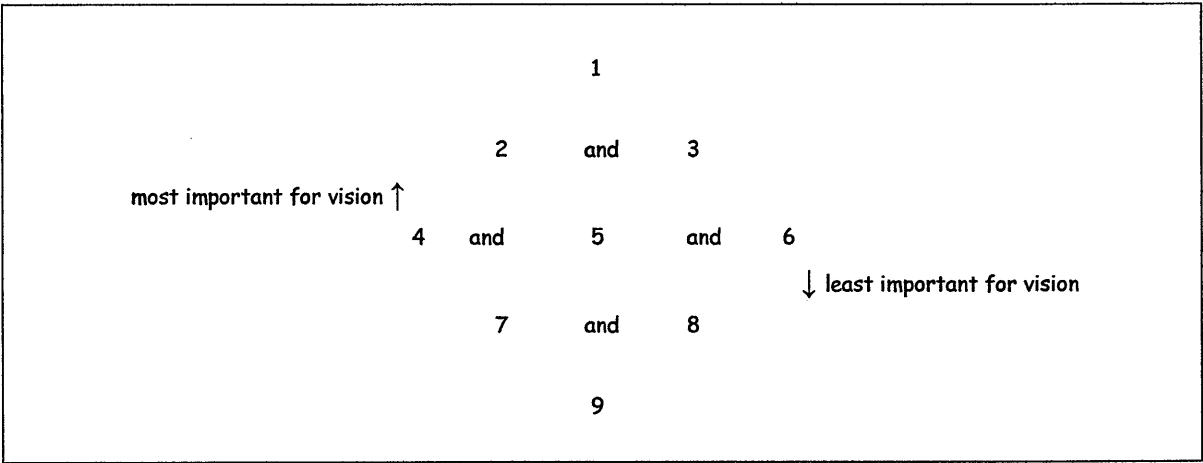


Figure 9.3: Diamond-shaped rank

If the child needed further help with reading the factors this was given, but no feedback or opinion was given when the child made comments about the relative importance of each factor. When the child had finished the task, the researcher asked him or her to check it and to make any changes if desired. When the child was satisfied with the arrangement of the cards, the researcher recorded the order on a proforma (see Appendix 6) and then asked the child to explain why she/he had chosen the factors that appeared in rows one and two of the diamond. The comments were recorded on the same proforma. The child’s efforts were praised and he/she was thanked for participating in the research.

9.4.1.5. Scoring

Scores for each factor were calculated by awarding points from one to five up the rows of the diamond (i.e. a score of one for the factor at the bottom, two each for the two factors on the row above; three for each of the three factors across the middle, four for the two in the row above and five for the factor at the top of the diamond).

9.4.2. Results

The median and range for each factor for the blind and sighted groups are shown in Table 9.4.

Table 9.4: Median and range for each factor in the Ranking task

Factor	Visual status	N	Median	Range	Minimum	Maximum
eyesopen	sighted	50	5.00	4.00	1.00	5.00
	blind	12	4.00	2.00	3.00	5.00
light	sighted	50	3.00	3.00	1.00	4.00
	blind	12	3.50	3.00	2.00	5.00
healthofeyes	sighted	50	4.00	4.00	1.00	5.00
	blind	12	4.50	2.00	3.00	5.00
distance	sighted	50	3.00	4.00	1.00	5.00
	blind	12	3.00	3.00	1.00	4.00
noise	sighted	50	2.00	3.00	1.00	4.00
	blind	12	2.00	1.00	1.00	2.00
corners	sighted	50	3.00	3.00	1.00	4.00
	blind	12	3.00	2.00	1.00	3.00
smells	sighted	50	2.00	3.00	1.00	4.00
	blind	12	1.00	1.00	1.00	2.00
barriers	sighted	50	3.00	4.00	1.00	5.00
	blind	12	3.00	3.00	1.00	4.00
sizeofobject	sighted	50	3.00	4.00	1.00	5.00
	blind	12	3.00	2.00	2.00	4.00

The blind and sighted children judged the importance of each factor very similarly, and this can be seen clearly in Figure 9.4, which shows a comparison of the median scores for each factor between the blind and sighted children.

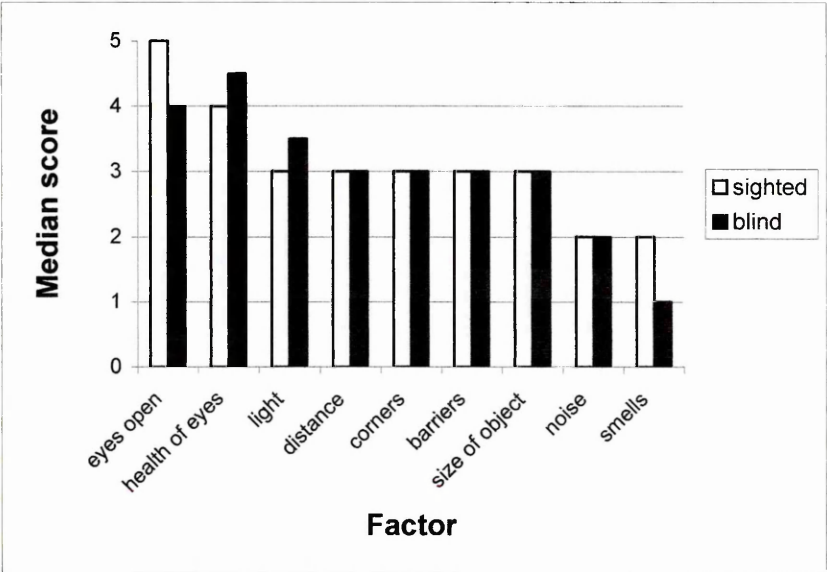


Figure 9. 4: Median scores for each factor in the Ranking task for the blind and sighted children.

A series of Mann-Whitney U tests, using a Bonferroni adjusted p level of 0.006 (to allow for the number of comparisons being made), showed that there were no significant differences between blind and sighted children in the importance they attached to any of the factors. Table 9.5.shows the U and p values for each factor.

Table 9.5: Mann-Whitney U and p values for each of the nine factors in the Ranking task

Factor	N ₁	N ₂	Mann- Whitney U	p value
Eyes open	50	12	271.50	0.58
Light	50	12	224.50	0.15
Health of eyes	50	12	232.50	0.20
Distance	50	12	268.50	0.52
Noise	50	12	214.00	0.09
Corners	50	12	263.00	0.48
Smells	50	12	182.50	0.03
Barriers	50	12	272.50	0.61
Size of object	50	12	280.00	0.71

The comments gathered from the second part of the task, where the children were asked to explain why they had chosen the factors that appeared in rows one and two on the diamond were rich and varied in content, and in order to capture this diversity, a more qualitative approach was applied to these data. For the purposes of comparison, the sighted children were divided into two age-groups, the young aged between 8;0 and 10;6 ($M = 111.08$ months, $SD = 9.45$ months), and the old aged

between 10;7 and 12;11 ($M = 139.48$ months, $SD = 9.39$ months). The blind children, as reported in Section 9.4.1.1. were aged between 7;11 and 14;8 ($M = 124.75$ months, $SD = 25.66$ months). The data were coded for particular themes in order to condense the information and make it more manageable. Each factor was addressed systematically, and descriptive labels were assigned to each chunk (piece, which may be an individual word or short phrase) of data. The chunks of data were then assigned to descriptive categories. In order to ensure the reliability of the researcher's coding of the children's comments, 25 per cent of the responses were independently categorised by another rater. Inter-rater agreement, calculated by dividing the number of identical allocations by the total number of allocations, was .98.

Each of the nine factors will now be considered in turn, and some of the comments made by the children will be given as examples.

Eyes open

Overall, 82 per cent of children rated open eyes among the three most important factors (80% young sighted, 84% old sighted and 83% blind). Comments about this factor were straightforward to code, and most fell into a category described as 'general', in which the comments were descriptive rather than explanatory, and included reference to "can't see at all", "can't see anything", "need your eyes open if you want see" and formed the bulk of responses across all three groups. Some 'general' comments did include more detail than those given above, and a selection from each group is quoted here as an example: "If your eyes are open, you can see everything in front of you" (sighted child aged 8;8); "If your eyes are closed, you can't see anything, even if it's near and there are no barriers and stuff" (sighted child

aged 10;2); “If you close your eyes, you’ll keep bumping into things” (blind child aged 7;11).

However, four children were able to offer explanations for why closed eyes prevented vision, and three of these related to the eyelids as an obstacle to vision: “If they [eyes] are closed, it’s pitch black, because your eyelids aren’t transparent” (sighted child aged 9;3); “You can’t see *through* your eyelids so you’ve got to open your eyes” (sighted child aged 12;4); “Your eyes need to be open to see – if they’re not, they block out the seeing. What blocks? The eyelids!” (blind child aged 10;2).

One child referred to the necessity of light entering the eye for vision to be possible: “Eyes must be open, if they’re not they don’t let any light in and you can’t see” (blind child aged 10;3).

Health of eyes

Health of eyes was selected by 69 per cent of the children within the top three most important factors (52% young sighted, 76% old sighted and 92% blind). The themes that emerged from the initial coding of the data fell into two categories: ‘types of eye health’ and ‘effects of eye health’. Within the two categories, sub-categories were identified. Within the first, children either referred to ‘non-specific eye health’, or to ‘specific types of diseases or conditions’ affecting the eyes. In the young sighted age-group, non-specific eye health was limited to two types: ‘bad’ or ‘unhealthy’ eyes or eyesight (62% of the total non-specific eye health comments), for example “If your eyes are bad you can’t see well” (sighted child aged 8;3) and ‘good’ or ‘healthy’ eyes (38%), for example “The healthier your eyes are the better you can see” (sighted child

aged 8;4). In the old sighted group also, children referred to bad/unhealthy (66%) and good/healthy eyes (17%), but some also mentioned 'weak' eyes (17%), for example "If your eyes are weak, your sight will be blurry" (sighted child aged 12;4). The blind children also referred to bad/unhealthy (42%) and good/healthy eyes (25%), but not to weak eyes, and additionally there were references to eyes not working or not working properly (33%), for example "If your eyes don't work properly, you won't see properly" (blind child aged 11;0).

In the young sighted group, only two children mentioned specific eye problems. One child aged 8;8 referred to foreign objects in the eye: "If you get something in your eye – an eyelash or some sand, then your eyes water and you can't see properly". The other, aged 10;2 said, "If you never went to sleep and your eyes felt really tired, they wouldn't be healthy and you wouldn't see properly". The comments of the old sighted group were much more specific and included reference to blindness (36%), cataracts (21%), infections (29%), no eyes (7%) and short sightedness (7%), for example, "If you're blind you can't see" (sighted child aged 11;4), "If you've got cataracts, it'll stop you from seeing" (sighted child aged 10;8), "You might not see properly if you have an infection" (sighted child aged 12;0), "If you have no eyes you can't see, 'cos eyes are the only thing you see with" (sighted child aged 10;8), "If your eyes are ... short-sighted, then you won't see clearly" (sighted child aged 12;2). Half of the responses of the blind children, unsurprisingly, contained reference to blindness, for example "People who haven't got healthy eyes sometimes are blind" (blind child aged 10;2). There was one reference to short-sightedness, and two references to eye disease, for example "If your eyes have a disease, you can be blind or not see properly" (blind child aged 11.8).

Comments about the effects of health of eyes fell into five categories: 'general'; 'distance'; 'clarity'; 'range' and 'other'. Most were related to general, non-specific effects such as not seeing well or properly. More than half (60%) of the young sighted children's responses were in this category, with comments such as, "If you don't have health in your eyes, you won't see too good" (sighted child aged 9;2). Almost three quarters (71%) of the old sighted children and most (78%) of the blind children made similar responses, which fell into the general category. Two of the young sighted age-group mentioned that poor eye health would impact on how far the eyes can see: "You can see further when your eyes are in health" (sighted child aged 8;3), but no old sighted or blind children made reference to this. One young sighted child and one blind child commented about how eye health affects the extent of what is seen: "You could see *more* if your eyes were healthy" (blind child aged 7;11).

Light

Light was rated among the three most important factors by 34 per cent of the children (32% young sighted, 28% old sighted and 50% blind). Initial coding revealed that most of the comments were purely descriptive in nature, and related to the absence of, rather than the presence of, light (categorised as 'dark'). A few children attempted to illustrate their comments by a comparison of the effects of light and darkness (categorised as 'light and dark'). Even fewer extended their explanation by referring to the degree of vision that is possible in the absence of light (categorised as 'degree of vision').

Most responses fell into the 'dark' category: 50 per cent for the youngest group's comments; 43 per cent of the oldest group's comments; and 50 per cent of responses

from the blind children. Typical comments include “If there’s no light in your room you can’t see anything” (sighted child aged 9;6), “If it’s dark you can’t see anything” (sighted child aged 12;0), and “I know that people can’t see in the dark. I’ve just heard people say ‘Put the light on! I can’t see!’” (blind child aged 8;2) .

Only a few children gave responses that compared the effects of light and darkness (13% young sighted children, 43% old sighted children and 33% blind children): “If it’s too light you’re dazzled and you have to close your eyes, but if it’s dark, you can’t see at all” (sighted child aged 9;3); “If it’s bright you can see, but if it’s too bright you get destructed vision and it can spoil your eyes and you’re dazzled, but if it’s dark, you can’t see” (sighted child aged 11;2); “People can’t see in the dark – it’s got to be at least a little bit light or you can’t see at all” (blind child aged 14.8).

None of the old sighted children suggested that in some situations, it is possible to have some degree of vision even in the dark, and their responses all tended to refer to seeing or not seeing at all. However, three children in the young sighted group and one blind child made interesting comments, and all are worth reporting. One sighted child (aged 9;5) said, “If it’s light you can see clearly, but you can’t see good in the dark. It’s kind of dim and shadowy, just like ... outlines of things”. Another (aged 9;6) said, “If you’re in the dark you can’t see good, just dark shapes, but if it’s light you can see really well”. A third (aged 10;6) said, “If it’s dark, well, you can hardly see anything, only light coloured things sometimes”. The comment of a blind child (aged 8;11) was less detailed, but nevertheless indicated some knowledge of degrees of vision: “You can’t see in the dark – well, only a bit”.

Distance

Distance was ranked within the three most important factors by a total of 27 per cent of the children (32% young sighted, 16% old sighted and 42% blind). Children tended to explain their choice of this factor by referring to the effects of distance on ‘clarity’, ‘size’ or ‘invisibility’, and the comments were categorised according to those themes.

Most (63%) of the young sighted children’s responses included some reference to clarity, for example, “When someone’s far away, you can’t see them clearly” (sighted child aged 9;11). Two (50%) of the old sighted children alluded to clarity and one said, “If things are coming from a long distance you won’t see them clearly, but if they’re close you will see them clearly” (sighted child aged 11;3). Most (80%) of the blind children commented about clarity when asked about the effects of distance, and a typical answer was: “When an object is far away, you can’t see it as well as close up” (blind child aged 8;11).

Three children (37%) in the young sighted group remarked about how the size of an object appears to be smaller the further away it is, for example “When you’re far away it makes the thing look as small as an ant!” (sighted child aged 8;9). There were no responses from the old sighted or blind children in this category.

The third category, ‘invisibility’, contained references to not being able to see at all and two old sighted children and one blind child gave comments of this type: “You can’t see things that are far away” (sighted child aged 11;4); “Things that are far away can’t be seen” (blind child aged 11;0).

Corners

Ten children (16%) placed corners among their most important three factors, three (12%) from the young sighted group and seven (28%) from the old sighted group. None of the blind children cited this factor. Coding was straightforward, with clear themes emerging from the data. Four sighted children aged 9;9, 12;6, 12;8 and 12;9 simply stated that, “You can’t see round corners”, and when pressed for explanations said, “You just can’t” or similar. A further three children illustrated their comments with examples, although these were again purely descriptive, with no attempt to explain why vision is affected by corners, for example, “If someone’s round a corner, you won’t be able to see them” (sighted child aged 9;2). One young sighted child and two old sighted children gave responses that fell into the third category, which included attempts to explain why corners affect vision, with reference to vision not travelling around angles or bends, for example, “You can’t see round corners ‘cos sight won’t go round angles” (sighted child aged 11;0).

Barriers

Barriers was ranked among the three most important factors by a total of 24 per cent of the children (20% young sighted, 28% old sighted and 25% blind). Three general themes were identifiable from the data: simple responses that referred to not being able to see through, past or around barriers with no attempt to explain why (60% young sighted, 14% old sighted, 33% blind), references to barriers blocking vision (20% young sighted, 14% old sighted and no blind) and responses that alluded to transparency (20% young sighted, 71% old sighted, 66% blind).

The young sighted children mainly gave responses in the first category, for example, “You can’t see through things’ (sighted child aged 8;6). One old sighted and one young sighted child referred to barriers blocking vision, for example, “Sight can’t go through barriers, things are blocked out” (sighted child aged 12;7). Most of the children in the sighted group, and two of the three blind children who cited barriers among the three most important factors referred to transparency in an attempt to justify their choice. A sighted child aged 12;8 said, “You can’t see *through* anything except see-through things – windows and thin tops [clothes], or like, net curtains”. Both the blind children’s responses on this theme were of interest and used quite complex language or examples: “Barriers block sight, air doesn’t block vision even though it’s in-between. Also, transparent barriers like windows don’t block, you see through them, or through plastic curtains because the light gets through” (blind child aged 11;2); “If barriers are opaque you can’t see through them or past them, but if they’re transparent like glass, then you can” (blind child aged 13;5).

Size of object

In total, 19 per cent of children (24% young sighted, 20% young sighted, 8% blind) rated size of object among the three most important factors that affect vision. Again, responses usually fell into clear categories, with three (50%) young sighted children and three (60%) old sighted children giving simple descriptive answers that referred to largeness and/or smallness such as, “Really big things are clearer to see” (sighted child aged 8;9), or “If it’s big you can see it, if it’s small you can’t” (sighted child aged 11;4). Two children gave slightly more descriptive answers and referred to bad eyesight affecting people’s ability to see small things (sighted child aged 8;9) and the lack of visible detail on small things (sighted child aged 11;4), but even these

responses were purely descriptive rather than explanatory. The second category of response included examples of large and small things that could be seen or not seen easily, such as a giraffe (sighted child aged 8;0), an elephant (sighted children aged 10;2 and 12;0), a digger (sighted child aged 12.0) in the case of easily seen objects, and a crumb (sighted child aged 8;9), a fly (sighted children aged 10;2 and 11;4), and molecules and viruses (blind child aged 11;8) for hard to see objects.

Noise

Very few children (10%) rated noise among the three most important factors, and the majority of those who did (67%) were in the young sighted group. No blind children rated this factor of high importance. One of the old sighted children gave the rudimentary response, “You need to hear things in order to see them clearly” (aged 10;9) and when asked why this was so, said, “You just do”. Three of the four young sighted children related their answers to road traffic safety, for example, “You need to hear what’s coming, look *and* listen for traffic. That’s how you see it well – if you don’t listen you don’t see it proper either” (aged 8;6). The two remaining responses are worthy of note. One (aged 8;3) said, “If you’re blind, you hear a noise and then you pretend that you can see and you know where you’re going” and the other (aged 11;2) said, “If someone screams, you can’t see well”.

Smells

Only three children (5%) cited smells among their three most important factors, and these were all sighted, aged between 8;0 and 8;9. In all cases the children found it difficult to express why they had placed this factor high on the grid. Two of them talked about a smell getting their attention and motivating them to go and find the

source of the smell, for example, “If you smell something you want to go and see it, like a fire or a barbeque” (sighted child aged 8;9), while the third said, “If you can’t see or hear but you’re good at smell, you can smell everything instead and you’ll be OK” (sighted child aged 8;3). She was unable to elaborate further and simply said, “You would just be OK as long as you could smell stuff ... you just would be”.

9.4.3. Discussion

The results indicate that blind and sighted children hold very similar beliefs about the factors they were asked to consider in this study, which were originally selected by sighted children in the first two stages of this current study. Thus, the hypothesis that they would differ in their opinions was not supported by the findings. Given that sighted children generally perform better than blind children on visual perspective-taking and visual inference tasks, this finding is surprising. It seems that blind children know that these factors *affect* vision, but the nuances and complexities of exactly *how* they affect vision are unclear, as was demonstrated by blind children in the study reported in Chapter Eight in relation to the effects of distance in particular. Both the blind and sighted children ranked open eyes and healthy eyes as most important, and noise and smells as least important. Distance, light, barriers, corners and size of object were ranked in between. The findings of previous studies, where blind children have been less able than their sighted peers to succeed on visual perspective-taking tasks suggested that blind children would tend to rank the factors in random fashion, rather than follow an almost identical pattern to that of sighted children, or rank the factors in a different order, reflecting the errors they make in visual inference and visual perspective-taking tasks.

One explanation for this finding is that although blind children have some knowledge about the visual experiences of sighted people, their knowledge is based upon explanations about how vision functions, or upon information gained incidentally, rather than being first-hand and experiential. Knowledge of this type may be difficult to assimilate with accuracy, so although blind children may be able to state, for example, that open eyes are fundamental to the ability to be able to see, the detailed understanding of vision that is often necessary for visual inference and perspective-taking tasks is much more difficult to achieve.

It is helpful at this stage to consider Flavell's theory of the development of perspective-taking skills (Flavell et al., 1968), which suggests that children gradually develop the understanding that other people see things, as they themselves do, but in the Level 1 stage of development (usually achieved at between two to four years of age in sighted children) they do not appreciate that an object seen simultaneously by both themselves and another person is seen differently from different spatial aspects. At around four years of age, Level 2 understanding begins to emerge, and is usually complete by age seven. Then the child understands that not only can people see objects, but also that they can have differing visual experiences of the same object while looking at it from different positions. It is possible that blind children find it much more problematic to develop complex Level 2 knowledge than do their sighted peers, because they do not have any direct experience of how various phenomena affect vision in order to update and refine their abilities. The rule about occluding objects is clear, and sighted two-and-a-half- to three-year-old children are familiar with this, and can make predictions about what another person can see using this rule if the cues are unambiguous (Flavell, 1978; Lempers et al., 1977). However, the

effects of phenomena such as distance upon vision are much less extreme, and rather than an 'all-or-nothing' result, the vision gets less clear, and the object appears smaller the further away it is. Perhaps then, these are the types of effects that blind children find hard to assimilate, and which cause confusion in visual perspective-taking tasks.

The example of distance is interesting, and is useful in illustrating this point further. Many studies have been conducted on the development of size constancy (accurate perception of objective size despite changes in distance and size of retinal image) in children (e.g. Rapoport, 1967; Zeigler & Leibowitz, 1957). These studies have shown that sighted children of five years of age frequently misperceive the size of distant objects, but as they get older, their abilities improve dramatically, and by the age of 11 years, adult levels of accuracy are achieved (Brislin & Leibowitz, 1970), although perfect size constancy is rare, particularly over long distances. In order to be able to predict how an object might look to another person at a distance, children need to be aware that objects look smaller the further they are away from the viewer. A key question in theories of size constancy is what exactly causes these improvements in performance? It has been suggested that size constancy is an innate ability (Day & McKenzie, 1981; Slater, Mattock, & Brown, 1990); or that it is a product of developmental improvement in perceptual abilities (Leibowitz, 1974); or that it is achieved through cognitive development and the ability to engage in cognitive strategies that supplement actual perceptual experience (Granrud & Morreale, 2001). The latter is known as the cognitive supplementation hypothesis in which knowledge about the effects of distance upon vision, gained experientially, is used to make accurate predictions about the size of an object when it is viewed from a distance.

All these theories have supporting evidence, but what is important for the current discussion is that first, if the ability is innate, then it is innate (although of necessity, because of the absence of vision, experientially untried) in blind children as well as sighted children. Furthermore, even if it is innate, there must be other factors that affect its development, otherwise there would not be such a dramatic age-related improvement. Second, for blind children, there can be no improvement in perceptual ability in the visual modality. Third, if, as Granrud and Morreale (2001) and Granrud (2004) suggest, performance is improved by the ability to apply cognitive strategies that supplement perceptual information with experiential knowledge, blind children are greatly disadvantaged in their understanding about the effects of distance upon vision, as they will never gain that experiential knowledge, and can only be familiar with a general heuristic that the further away an object is, the smaller it looks. As Flavell and his colleagues (1991) speculated, increasing sensitivity to perceptual phenomena, combined with a growing capacity to recognise and reflect upon what and how they themselves see is what help children to attain an explicit understanding about visual rules.

The lack of personal visual experience was often apparent in the comments of the blind children and while many of their remarks demonstrated quite sophisticated knowledge about the factors that affect vision, at times, confusion was in evidence. For example, one blind child (aged 13;5) regarded corners as not important on the grounds that “If there’s enough light and the angle isn’t too sharp, you can see around corners”.

Old sighted children generally placed noise and smells in the fourth and fifth gridlines, but a number of the young sighted children placed one or both of these factors in the third or even second positions. This suggests that young children tend to experience what is sometimes termed a ‘merging of the senses’ (Stein, 1993), the child being unable to differentiate clearly one type of sensory information from another. This was further illustrated by the comments they made when asked to explain why they placed certain factors at the top of the grid, and, without exception, they struggled to explain exactly why they thought that noise and smell affected vision, even if they had been extremely articulate when explaining their other choices. Of all the children who rated smells or noise among the three most important factors, only the sighted child aged 11;2 who said, “If someone screams, you can’t see well” implied that this information interfered with, rather than enhanced, his ability to see, as the other children’s comments had suggested. Interestingly, not even the youngest blind children placed noise and smells above the bottom two positions on the grid, and one blind child aged 14;8 was reluctant to place smells on the grid and wanted to omit it altogether saying, “*Smells!* Well, they *don’t* affect vision *at all!*”

The comments of the blind children frequently suggested that there were two main sources of information upon which they had drawn whilst doing the Ranking task and explaining why they had chosen their most important factors. First, they often said that someone had told them, or that they had heard people say something about the factor under discussion, for example, “ ... I’ve just heard people say ‘Put the light on! I can’t see!’” (blind child aged 8;2 on the effects of light); “I know because people have told me that *tiny* things like viruses and molecules have to be looked at through a

microscope to see them. They can't be seen by the ordinary eye on its own" (blind child 11;8 on the effects of size).

Second, the language that the blind children used often suggested that they were drawing upon scientific knowledge gained in the classroom and there were several references to transparency, opaqueness and the role of light in vision, both in terms of entering the eye, for example, "Eyes must be open, if they're not they don't let any light in and you can't see" (blind child aged 10;3), and passing through transparent barriers, for example, "... transparent barriers like windows don't block, you see through them, or through plastic curtains because the light gets through" (blind child aged 11;2). Comments of this type indicate that blind children learn about vision both through incidental learning and direct teaching, and this area will be explored further in Chapter Twelve.

This study elicited rich data about the beliefs of blind and sighted children about factors that affect vision, and also drew out a number of comments that identified areas of misunderstanding and confusion, particularly in the case of the blind children. Study 4 aimed to utilise some of these comments, and also, comments made in previous studies to explore blind and sighted children's knowledge about how vision may be clear or indistinct, depending on a number of basic phenomena.

CHAPTER TEN

STUDY 4: TRUE OR FALSE? BLIND CHILDREN'S UNDERSTANDING OF THE COMPLEXITIES OF VISION

10.1 Introduction

A key finding to emerge from the previous study was that congenitally blind children's opinions about the importance of nine factors that affect vision, identified by sighted children, are very similar to the opinions of their sighted peers. As discussed in the last chapter, this finding is relevant, not least because many studies, including studies reported earlier in this thesis, have shown that blind and sighted children *differ* in their ability to infer the visual experience of another person, with sighted children performing more accurately than children who are blind.

It has been demonstrated that congenitally blind children experience problems when trying to predict the effects on vision of some of the factors explored in the last study. Many of the comments made by blind children indicate that the confusion is not simply about whether an object is or is not visible, but about the clarity of that object to the viewer. Misunderstanding about the effects of distance on vision has been well documented (e.g. Bigelow, 1991a; Bigelow, 1991b, 1992; Nock et al., 2003b; Nock et al., 2004). Comments made by some blind children reported in Chapter Eight give some insight about the nature of their misunderstanding. For example, a nine-year-old blind child knew that he could be seen by a person standing at approximately 15 metres away, facing toward him and with no occluding barriers, but added, "He won't be able to see the colours of my uniform though, 'cos he's too far away to see colours now", and went on to say that colour can only be seen "... close up, like really near"

and indicated an arm's reach distance. An eight-year-old blind child knew that he was visible to an observer at a distance of approximately 15 metres, but believed that he could not be seen clearly: "She won't see me clearly though, some bits will be missing ... like she can't catch it all ... some will be blurred. She can see my head 'cos that's high up."

Similarly, blind children's misunderstanding about the effects on vision of intervening objects has been demonstrated in several studies (Bigelow, 1991a, 1991b; Nock et al., 2003b; Nock et al., 2004). Blind children taking part in Study 2 of this thesis again shed some light upon how they believe barriers affect vision. For example, a blind seven-year-old wrongly believed that she could be seen when she was hidden behind a gymnastic vault. She explained why she thought that she could be seen by saying "Because she'll see round it ... look, like this" and traced the path that she thought the line of vision followed with her hand. This error is related also to the effects on vision of angle, and the mistaken belief of some blind and young sighted children (e.g. Boydell et al., 2003; Flavell et al., 1991) that vision can travel around corners and bends, indicting that they have not grasped the 'straight-line rule'.

However, while some blind children demonstrate that they believe that the line of sight can bend, others over-estimate the effects upon vision of angle. For example, Nock et al. (2003a) reported that a nine-year-old blind boy at a 12-metre distance and up a slight incline from a sighted viewer said, "She can only see my head because it's higher, but not my body, it's too low". Blind children's overestimation of the effect of angle has also been documented by Nock et al. (2003b) and Bigelow (1991a).

Blind children's confusion about the effects upon vision of other sensory modalities has also been documented. For example, Bigelow (1988) reported that a blind four-year-old, when asked to show objects to a sighted observer guided the observer's hands to touch the target object. Nock et al. (2003a) drew attention to how blind children may experience confusion about how sensory information from other modalities affects vision when they reported that a blind ten-year-old blind child explained that he was visible to a sighted observer because it was windy. When asked why this was so, he replied, "The wind will carry his vision".

Some blind children have demonstrated confusion about how movement of a target object may affect its visibility. When asked if the toy bear was visible through a wire mesh screen, a six-year-old blind girl responded 'You can't see it, 'cos it's keeping very, very still', possibly indicating that she did not understand how movement affects vision (Nock et al., 2003b).

Anecdotal evidence also sheds some light upon how blind children may experience confusion about how some phenomena affect vision. The teacher of a blind nine-year-old described how he could not understand how she could see him through the classroom window when he was "... messing about in the corridor". She told him that he should know about transparency as they had only recently talked about it in science. She went on to say that the child seemed really surprised, and said that he knew that it was possible to see through things that are transparent, but not well enough to actually recognise a person (personal conversation).

Anecdotal evidence also suggests that some blind children may experience problems when trying to understand reflection. A blind 14-year-old, when talking about how light affects vision in Study 3, raised the subject of mirrors. He said that he could not understand how colours could be seen in a mirror: “I know now that you can see colour in a mirror, but for a long time I thought mum was having me on. Me and [*blind friend’s name*] used to be talking about it and he didn’t believe it either!” (personal conversation). This echos the comment reported by the mother of a five-year-old blind child when her sister was applying make-up: “She said to [*sister’s name*] ‘You better check that that lipstick matches your dress’. Her sister said ‘I’m looking in the mirror and it matches.’ She [*blind child*] kept saying ‘No, the colours, the colours! How can you see the colours in a mirror?’” (personal conversation).

The present study aimed to explore further the opinions of blind and sighted children about factors that affect vision by developing a ‘True or False’ type task, focusing on misunderstandings and misconceptions reported in previous studies and in the earlier studies documented in this thesis (as referred to in Section 1.1). The study was designed to explore further blind children’s misunderstanding about the effects upon vision of: angle (e.g. Bigelow, 1991a; Boydell et al., 2003; Flavell et al., 1991; Nock et al., 2003a, 2003b); distance (e.g. Bigelow, 1991a, 1991b, 1992; Nock et al., 2003b; Nock et al., 2004), (see also the reference to Study 2, pp. 211 to 212); movement (e.g. Nock et al., 2003b); opaque and transparent barriers (e.g. Bigelow, 1991a; Bigelow, 1991b; Nock et al., 2003b; Nock et al., 2004), (see also the reference to personal conversation, p.213, para. 3); other sensory modalities (e.g. Bigelow, 1988; Nock et al., 2003a); reflection (see reference to Study 3 and personal conversations, p. 214, para. 1); and the effect on vision of wind (e.g. Nock et al., 2003a). These topics of investigation were based on comments made by blind children in Studies 2 and 3 and

also from comments made in earlier studies carried out by Nock and her colleagues (Nock et al., 2003a, 2003b; Nock et al., 2004) and Bigelow (Bigelow, 1988, 1991a, 1991b, 1992), reported above, which indicated that blind children experience some confusion, not simply about whether an object is visible or not, but about the clarity of that object to the viewer. These topics were identified as most significant arising from the sources mentioned. On the basis that sighted children tend to perform better than blind children on visual perspective-taking tasks, the hypothesis was that sighted children would score higher overall than the blind children on the True or False task.

10.2. Method

10.2.1. Participants

The participants were the same 12 congenitally blind children who took part in Study 3 aged between 7;11 and 14;8 ($M = 124.75$ months, $SD = 25.66$ months) and 12 sighted children, matched for age (year and month) and sex ($M = 124.75$ months, $SD = 26$ months) (Table 10.1).

Table 10.1: Age and sex of blind and sighted children participating in the True or False task

Age	Sex	Age	Sex
7;11	f	10;3	m
7;11	f	11;0	m
8;2	f	11;2	f
8;11	m	11;8	m
9;6	m	13;5	m
10;2	f	14;8	m

The sighted children were recruited from three primary schools in the West Midlands. The catchment area of one was largely middle-class, while the other two were predominantly working-class. A letter was sent to the families of all sighted children in the target age-group, informing them that the researcher would be in school on a specified date collecting data from various tasks and that if they did not want their

child to participate they should opt out by completing a tear-off slip at the bottom of the letter (see Appendix 2C). This was at the request of the Headteachers of the schools involved, and was acceptable to the researcher, as ethical guidelines state that consent can be gained from those acting *in loco parentis* (HPMEC, 2006, p.1). In the event, no sighted children's families opted out. (Refer to Section 6.3.2. for detailed information on recruitment and ethical considerations.)

10.2.2. Design

A 'True or False' verbally administered task, containing 16 statements about vision, eight of which were true and eight of which were false, was administered to each child. The statements fell into six categories, which had been problematic for blind children in earlier studies: angle; distance; movement; barriers; other sensory modalities; and miscellaneous (the final category including statements about reflection and the effects on vision of wind). The children were asked to state whether the statement was 'true' or 'false'. The statements were read in random order and the order was different for each child.

10.2.3. Materials

Sixteen statements were produced to explore misunderstanding about the effects upon vision of angle (Statement (S) 1 to 5), distance (S6 to S8), movement (S9 and S10), barriers (S11 and S12), other sensory modalities (S13 and S14) and miscellaneous (S15 and S16) (Table 10.2). The statements were printed on a proforma, which was used by the researcher to administer the task and to record the children's responses (Appendix 7). The children rang a small bell to indicate that they believed a statement

to be true, and used a small hooter to indicate that they believed a statement to be false.

10.2.4. Procedure

Each child was tested individually. First, the child and the researcher chatted briefly in order for the child to be put at ease. When the researcher judged that the child was comfortable and relaxed, she invited the child to sit with her at a table and then said, *"Today, we're going to play a game. I'm going to read some sentences to you, and you need to decide whether what I say is true or false."* The child and researcher talked about the meaning of true and false, with the researcher giving corrective feedback where necessary. The researcher asked, *"Do you know what 'true' means?"* If the child answered correctly, for example by saying that when something is true, it is correct or right or it really happened, the researcher said, *"Yes, that's right."* If the child was unclear about the meaning of the word, the researcher explained by saying, *"When something's true, it means that it's right or correct, or it really happens. So if I say to you, 'My name's Jenny', then that's true. Do you understand now?"* She then followed the same procedure for clarifying the meaning of 'false'. If the child was unsure of the meaning of the word, the researcher explained, saying, *"When something is false, it means that it's not true or it didn't happen. So if I say to you 'My name's Eric', then that's false."* Once the child was judged to understand the meaning of 'true' and 'false', the researcher introduced the task and the objects to be used to respond, explaining and demonstrating that a small bell should be rung to indicate a 'true' response and a small hooter should be blown to indicate a 'false' response. She said: *"I'm going to say some things to you that are about seeing. Some of them are true, and some are false. If you think that what I say is true, shake the bell like this*

(demonstrating) *and if it's false, I want you to make this noise with the hooter* (demonstrating). *I'll say each sentence twice, and I want you to listen really well, and think carefully about whether it's true or false. We're going to have a practice first, to make sure that you understand."*

A 'Don't know' response was not provided as an option, because such a provision may have led to some children choosing not to take the risk of being wrong. On the few occasions that a child said that he/she wasn't sure, the researcher said, *"Well, go for the one that you think is most likely."* No child refused to respond. This could though, have led to some children randomly choosing a response, although this did not appear to be the case, and children thought carefully about their responses before making them, frequently expressing their thoughts as they tried to make a decision (see Section 10.4 for some examples).

Four training trials were then administered, using the following statements: "You are a [*insert child's gender*]" (true); "Today, the weather is snowy" (false); "Ducks say 'moo'" (false); and "You are in Year [*insert child's year group number*]" (true). If the child understood and responded appropriately, the researcher continued with the task, if not, she explained again, and repeated the training trials. In the event, only one child (a blind child aged 8;2) needed a second attempt. Most of the statements were straightforward. However, S2 and S3 referred to staircases, and children may have been considering different types of staircase, for example, some straight and some with bends or corners. In order to eliminate confusion, the researcher said to the children *"Some of the sentences might be about stairs or staircases. Do your stairs at home go straight up and down or do they have corners or bends?"* (The researcher

had visited all the blind children in their homes, and knew that two of them had staircases with corners). If the child replied that their staircase at home was straight the researcher said *“Well that’s the staircase I want you to think about.”* If the child said that they had a staircase with bends or corners at home, then the researcher said *“Do you know anyone who has a straight staircase?”* Two blind children and one sighted child had staircases with bends at home, but all were able to identify a straight staircase, either at school, or in a house they had visited. In the case of those children the researcher said *“Well that straight staircase, that’s the one I want you to think of if any sentences are about stairs. Do you understand?”*

The statements were then read in random order for each child, with each statement being read twice to allow adequate processing of information. The child responded by either ringing the bell or blowing the hooter, according to his/her judgement about the statement. Many of the children also responded verbally, saying ‘true’ or ‘false’ as they used the bell or hooter. The statements can be seen in Table 10.2.

Table 10.2: The 16 statements about vision that were used in the True or False task ('true' statements in bold print)

S1	Vision always has to be in a straight line.
S2	If someone stands at the top of the stairs, she can't see a person standing at the bottom.
S3	When someone stands at the bottom of the stairs, he can see a person standing at the top.
S4	If someone stands on a table, people on the floor can't see his head.
S5	Vision can't go round corners and bends.
S6	People standing at the back of the school hall can see a person standing on the stage, but not the colour of their clothes.
S7	People standing on the stage at school can see people at the back of the hall clearly enough to recognise their faces.
S8	Small things, like pins, can only be seen if they're near enough to touch.
S9	If a person is running other people can see them clearly.
S10	Things and people can't be seen if they are very still.
S11	Seeing through a window is as clear as seeing when there's nothing at all in between.
S12	If someone crouches down behind the settee, a person crouched down at the other side can see them.
S13	People don't need to touch things in order to be able to see them clearly.
S14	Things look clearer when they are making a noise.
S15	People can see colours in a mirror.
S16	When it's windy, people can see further.

After the child had responded to all 16 statements, the researcher asked her/him to comment about the erroneous responses they had made, saying, *"I'm going to ask you some questions about some of the answers you gave, because I want to know more about what you think."* So for example, if a child said that *Vision always has to be in a straight line* (S1) was false, the researcher said, *"You said that vision doesn't*

always have to be in a straight line; why is that?" The child's responses were recorded on the proforma.

10.2.5. Scoring

One point was given for each correct response and no points were given for incorrect responses. Thus, the maximum score was 16.

10.3. Results

Generally, both blind and sighted children demonstrated a good understanding of vision ($M = 10$, $SD = 2.22$, range 7 to 14, $M = 11.58$, $SD = 2.02$ range 8 to 14, respectively). Given the clear choice between two possible responses the children's responses can be compared with that expected by chance (i.e. a score of 8 over the 16 statements). The blind children's performance was significantly better than that expected by chance ($t = 4.96$, $df = 11$, $p < 0.01$), as was the performance of the sighted children ($t = 7.86$, $df = 11$, $p < 0.001$).

There was a significant difference between the total scores of the blind and sighted children ($t = -1.829$, $df = 22$, $p = < 0.04$, one-tailed), supporting the hypothesis that sighted children would score higher overall than the blind children on the True or False task.

In order to explore the relationship between age and understanding, Pearson's r was calculated. In the blind group, there was a significant positive correlation between age and score on the task ($r = 0.655$, $n = 12$, $p < 0.05$, one-tailed), but analysis of the data

from the sighted children did not indicate a relationship ($r = 0.051$, $n = 12$, $p = 0.436$, one-tailed).

Table 10.3 summarises the scores on each of the 16 statements in relation to the visual status of the children.

Table 10.3: Percentage of children correctly answering each of the True or False task statements

Statement number		S1	S2	S3	S4	S5	S6	S7	S8
Percentage correct	Blind	83.3	58.3	41.7	50	50	58.3	50	75
	Sighted	33.3	91.7	91.7	91.7	25	83.3	75	50
Statement number		S9	S10	S11	S12	S13	S14	S15	S16
Percentage correct	Blind	66.7	83.3	16.7	91.7	83.3	58.3	50	83.8
	Sighted	83.3	100	83.3	100	50	41.7	66.7	91.7

Chi-square analyses were carried out on all the statements. The analyses showed that two cells had an expected count less than 5 for all statements except 1, 11, 14 and 15. (The derivation of the null-hypothesis distribution of the chi-square test relies on the counts being fairly large, and it is recommended that all counts should be at least 5 (www.stats.ox.ac.uk/pub/StatMeth/SM4.pdf, 2007)). Therefore, for the remaining statements (2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, and 16) an exact significance test was selected for Pearson’s chi-square. Out of the 16 statements, there were significant differences in the blind and sighted children’s scores in only three: S1, *Vision always has to be in a straight line* ($\chi^2 = 6.171$, $df = 1$, $p = <0.05$, two-tailed); S3, *When someone stands at the bottom of the stairs, he can see a person standing at the top* ($\chi^2 = 6.750$, $df = 1$, exact $p = 0.027$, two-tailed); and S11, *Seeing through a window is as clear as seeing when there’s nothing at all in between* ($\chi^2 = 10.667$, $df = 1$, $p = <0.05$, two-tailed). For S1, the blind children were more likely to respond correctly, while for the remaining two statements, the sighted children were more likely than the blind

children to respond correctly. A summary of the non-significant results can be seen in Table 10.4.

Table 10.4: Summary of results in chi-square analyses of True or False task data (significant results in bold print)

No	Statement	χ^2	df	p (two-tailed)
S1	Vision always has to be in a straight line	6.171	1	0.050
S2	If someone stands at the top of the stairs, she can't see a person standing at the bottom.	3.556	1	0.155 *
S3	When someone stands at the bottom of the stairs, he can see a person standing at the top	6.750	1	0.027 *
S4	If someone stands on a table, people on the floor can't see his head.	5.042	1	0.069 *
S5	Vision can't go round corners and bends.	1.600	1	0.400 *
S6	People standing at the back of the school hall can see a person standing on the stage, but not the colour of their clothes.	1.815	1	0.371 *
S7	People standing on the stage at school can see people at the back of the hall clearly enough to recognise their faces.	1.600	1	0.400 *
S8	Small things, like pins, can only be seen if they're near enough to touch.	1.600	1	0.400 *
S9	If a person is running other people can see them clearly.	0.889	1	0.640 *
S10	Things and people can't be seen if they are very still.	2.182	1	0.478 *
S11	Seeing through a window is as clear as seeing when there's nothing at all in between	10.667	1	0.050
S12	If someone crouches down behind the settee, a person crouched down at the other side can see them.	1.043	1	1.000 *
S13	People don't need to touch things in order to be able to see them clearly.	3.000	1	0.193 *
S14	Things look clearer when they are making a noise.	0.667	1	0.414
S15	People can see colours in a mirror.	0.686	1	0.408
S16	When it's windy, people can see further.	0.381	1	1.000 *

* = exact p

Interestingly, although the difference in scores was not significant, the blind children scored higher than the sighted children on S5 *Vision can't go round corners and bends* and S13 *People don't need to touch things in order to be able to see them clearly*. The sighted children also achieved scores of 75 per cent or below on S7 *People standing on the stage at school can see people at the back of the hall clearly enough to recognise their faces* and S8 *Small things, like pins, can only be seen if*

they're near enough to touch, suggesting that many sighted children hold a erroneous opinions about a number of factors that affect vision.

10.4. Discussion

The results supported the hypothesis that the sighted children would score higher than the blind children on the task, which investigated knowledge about vision. However, when the statements were considered individually, there were significant differences in the results of only three: S1 *Vision always has to be in a straight line*, S3 *When someone stands at the bottom of the stairs, he can see a person standing at the top* and S11, *Seeing through a window is as clear as seeing when there's nothing at all in between*. More blind than sighted children responded correctly for S1 (83.3% and 33.3% respectively), while more sighted children than blind gave the correct response for S3 (91.7% and 41.7% respectively), as they did for S11 (83.3% and 16.7% respectively). For most of the statements then, explored by the true or false task, blind and sighted children demonstrated similar levels of knowledge.

In the statements where the scores were significantly different, the children's comments are of interest. Only four sighted children said that vision always has to be in a straight line. Many of the children who responded erroneously found it difficult to qualify their responses, and there was no clear theme identifiable from their comments. One sighted child aged 11;2 said, "Well you can see straight but it doesn't *have* to be", another said, "As long as things are small, you can see around them" (sighted child aged 14;8), but generally, the children tended to say that they could see anything they looked at, for example, "I look round corners and I can see everything" (sighted child aged 11;0), or "I can see straight and bendy as long as I'm looking with

my eyes open” (sighted child aged 8;2). Although these comments were quite surprising given the age of the children, they were in line with the findings of other studies that whilst children as young as three years demonstrate an *implicit* understanding that lines of sight are straight, this is not explicit knowledge of a ‘hard-and-fast’ rule; that is, young children *expect* lines of sight to be straight, but do not *explicitly* appreciate that lines of sight must *always* and *unavoidably* be straight (Boydell et al., 2003; Flavell et al., 1991).

By contrast, most of the blind children showed good knowledge of the straight-line rule and only two of them said that vision does not always need to be in straight lines. The blind child aged 11;0 explained his mistaken belief by saying, “You can have vision that’s not in a straight line, because when you drive, you have to go around bends and you can see where you’re going or else you’d crash”. The blind child aged 8;11 gave a similar response to the sighted 14-year-old, and said, “You can see in a straight line, but vision will go around things as long as they don’t block a thing completely. So, it goes round small things like ... bends around, but only a bit I think”. S5 posed the same question, but focused on the idea of bends rather than straight lines – *Vision can’t go round corners and bends* – and although the difference between the scores of the blind and sighted children was not significant, it is worth mentioning that fewer blind and sighted children responded correctly to this statement than to S1, and it was the poor performance of the sighted children, rather than the good performance of the blind children, that resulted in the scored between the two groups failing to reach significance. Some children made clear links between S1 and S5, and made reference to what they had said when asked about S1, for example, “It can [go round corners and bends] because like I said, driving, or even walking really,

you can see round a corner, maybe not clearly, but you can see it” (blind child aged 11;0). Others though, seemed unaware of the contradictory nature of their responses and said confidently that vision could not go around corners and bends but a few seconds later that vision did not have to be in a straight line, or vice versa. Such comments were made by both blind and sighted children across the age-range. One 13-year-old blind child stated with certainty that vision must be in a straight line but that vision was possible round corners and bends because “I think light will travel around corners and it’s light that you need to see”. Similarly, a sighted child of the same age said that vision can only go in a straight line. However, in response to the statement that vision cannot go around corners and bends said emphatically, “No way! You can see because I’m always looking around bends and corners. Your eyes do this” and he proceeded to trace a 90° angle in the air with his finger. This seems to suggest that some children, at least up until the age of 14 years, regardless of their visual status, are not explicitly aware of the straight-line rule, and interpret questions differently depending upon whether the main focus is upon straightness or bends and corners.

It is difficult to say with any certainty why the blind children scored significantly higher than the sighted children on the statement relating to the straight-line rule. Possibly sighted children learn incidentally through experience and do not ask questions of adults or more expert peers about vision. By contrast, blind children have to discover their knowledge about this rule verbally through asking questions and being told information about vision.

When someone stands at the bottom of the stairs, he can see a person standing at the top (S3) also produced significantly different scores. All but one sighted child responded correctly to this statement, but a majority (58%) of the blind children believed that a person standing at the bottom of the stairs could not see someone standing at the top. The sighted child said that "... the stairs get in the way" and that was why vision was not possible. This response was startling, given that the child was 11 years old and it is very likely that on many occasions he would have seen or been seen by someone when on a staircase. A possible explanation is that he misunderstood the statement, although this seems implausible, given his explanation of his response. The alternative is that he had difficulty imagining the scenario and extrapolating information from such an imaginary scene. Given that his overall score was low (56.25%), this possibility cannot be ruled out.

In the case of the blind children, there were seven erroneous responses and an obvious trend was observable in the children's reasoning. Six of the seven claimed that the stairs would block the observer's vision, while the seventh over-estimated the effect of angle upon vision, corresponding to Nock et al.'s (2003a; 2003b) and Bigelow's (1991) findings. Of those who claimed that the stairs blocked vision, most believed that this was the case for looking both up and down stairs (Statement 2) and made links between the two. For example, "You can't see up or down the stairs because it's up and down. You won't see because the stairs are there in front of you" (blind child aged 8;2), and "No way! Definitely not. You can *hear* but you wouldn't see. The stairs are in the way" (blind child aged 8;11). One blind child though, aged 13;5, made a distinction between the possibility of seeing down stairs but not up when he said "I think vision works when looking *down* stairs, because you can move your head

like this [*demonstrates*], but you wouldn't be able to get the angle correct to look up so far, so you can't see up but you can see down" (blind child aged 13;5).

The blind children had considerable difficulty with S11 - *Seeing through a window is as clear as seeing when there's nothing at all in between* – and again the sighted children achieved significantly higher scores. Ten blind children said that seeing through a window affected vision adversely and five of them referred to transparency in their responses. Their comments illustrate vividly how difficult it must be to comprehend the rules of a modality of which no experiential knowledge is held. One child said, "The glass is see-through, but I don't think it's as good. It can't be can it ... 'cos things in-between stop vision, so even see-through *must* stop it a bit. Maybe you can't see colours through it either" (blind child aged 11;8). All the blind children acknowledged that vision is possible through glass, but the words they used - 'blurry', 'unclear', 'dark', 'shadowy' indicated that they believed vision through a window is generally poor. It is important to note that despite the difficulties that some statements posed, the blind children were surprisingly articulate in their attempts to describe visual concepts. The following comment is typical of the creativity of the responses of the blind children: "A window, well glass is see-through, but you'll only see like ... shadows maybe, or maybe dark stuff... shapes. But if you need to see clearly, well you will need to either open the window and stick your head out, or, actually go outside" (blind child aged 7;11).

It is possible that S11 was misleading. Consider dirty windows, or obscured or frosted windows, tinted or stained glass windows. Vision through some glass is not as clear as when there is nothing in between the viewer and the target object. However, the

majority of sighted children (83%) judged that seeing through a window is as clear as seeing when there is nothing at all in between. Also, the explanations given by the blind children who judged that vision through a window is not clear did not include reference to dirty, obscured/frosted, tinted or stained glass, rather simply that windows in general obscure vision.

The statements fell into six categories: angle; distance; movement; barriers; other sensory modalities and miscellaneous, and the blind children's responses showed that within each of the categories, knowledge and understanding were inconsistent. For example, S11 and S12 related to barriers: *Seeing through a window is as clear as seeing when there's nothing at all in between*, and *If someone crouches down behind the settee, a person crouched down at the other side can see them*. The settee statement question caused almost no problems with only one blind child (aged 10;3) failing to respond correctly. The window statement, though, was answered correctly by only two blind children, so it is not the effect of barriers on vision *per se* that causes difficulty, but the type of barrier.

In conclusion, the findings of the present study again suggested that blind and sighted children's levels of knowledge and understanding about some factors that affect vision are similar, but in three areas, there were significant differences: explicit knowledge of the straight-line rule; knowledge about the effects of upward angle upon vision; and knowledge about vision through transparent materials. The question remains then, why, when blind children's levels of understanding about vision explored through tasks such as the ones described in Studies 3 and 4 are very good and similar to those of sighted children, they often perform at lower levels than their

sighted peers on visual perspective-taking tasks. It is possible that, although they know about vision through explanations from sighted people, they find it difficult to apply their knowledge to the types of artificial situations that are common in visual perspective-taking tasks. For example, as discussed in Section 5.2.1., blind children have been commonly asked to hide a body part or an object, and then to answer such questions as “Can I see your ... ?” , “Can I see you?” or “Can I see the toy?” depending on which was appropriate (Bigelow, 1991b). Another typical approach has been to ask blind children to show objects to a sighted observer (Bigelow, 1988), or to orient a geometric shape in a particular way for a doll to ‘see’ a specific side or face (Miletic, 1995). With this possibility in mind, the focus now shifts from asking children to predict whether they can or cannot be seen by a sighted observer when in positions dictated by adult rationale, or to discuss factors that affect vision, revealing though these activities have proved to be, to participation in a task following the format of a game of hide-and-seek. It was intended that the hiding behaviours of the blind children within a controlled environment within which a number of hiding locations were provided, would provide some insights about how they apply what they know about the factors that affect vision.

CHAPTER ELEVEN

STUDY 5: BLIND CHILDREN'S ABILITY TO HIDE THEMSELVES, AS DEMONSTRATED IN A GAME OF HIDE-AND-SEEK

11.1. Introduction

Children's hiding skills are believed to reflect their ability to infer what is seen by another person (Flavell et al., 1978). Most of the literature deals with hiding objects (e.g. Flavell et al., 1978) and body parts (e.g. Bigelow, 1991b), and there are few studies exploring children's ability to hide their whole body. Trafton and his colleagues (2006) pointed out that while there is a lack of empirical investigations of this nature, there are large amounts of anecdotal evidence, such as casual examination of game-playing behaviour at local parks, relating to the naturalistic game of hide-and-seek that indicate that even three-year-olds can play this game competently.

So how do children learn how to play hide and seek? Particularly for the purposes of this thesis, how do children learn how to hide? What skills do they need and do they actually need to be able to take the perspective of another person to be able to hide themselves successfully? Before considering blind children's hiding, the development of this skill in sighted children will be explored.

Young children can actively participate in a game of peek-a-boo, covering and uncovering their eyes with their hands at approximately seven months of age (Kleeman, 1973), at the same time as they begin to develop object permanence, shown to begin somewhere between five months (Baillargeon & DeVos, 1991; Baillargeon, Spelke, & Wasserman, 1985; Bower, Broughton, & Moore, 1971) and

nine months (Piaget, 1954). A skilled hider however, needs to be able to take the visual and spatial perspective of another person in order to be able to find the best hiding places and hide-and-seek seems to be rather more complicated than some of the simple tasks that have been explored in the laboratory (e.g. Flavell et al., 1981; Masangkay et al., 1974) (see Chapter Four), for a number of reasons. First, it usually occurs in a large-scale environment where the child cannot see the entire area at once. Second, the seeker may come upon the child from different directions, for example if the game takes place indoors, through different doorways, or if it takes place outdoors, from random routes. Third, the hider needs to determine if an object is big enough to hide inside, or under, or behind. Finally, there are many other things that are part of the game, including time pressure, the large quantity of available objects to hide under, behind or within, and the sizeable number of rooms or alternate locations.

As discussed in Chapter Four (Section 4.2.1.), Level 1 perspective-taking develops at between two and four years of age, when children begin to show an understanding that others as well as themselves see objects, and are also able to infer correctly what objects others can or cannot currently see if provided with adequate cues (Flavell, 1978; Wallace, Allan, & Tribol, 2001). However, four-year-olds are limited in their ability to take the visual perspective of another person, and although they demonstrate some rudimentary perspective-taking ability, they are nowhere near to having an adult-like understanding that other people see the world differently. How is it then that they are able to hide so successfully when playing hide-and-seek? Trafton et al. (2006) suggested that children of this age do not predominantly use visual perspective-taking skills when hiding. Rather, they proposed that three- and four-year-old children learn features and relations of objects (e.g. Smith, 2000) that are relevant

for the hiding game. For example, if they are to be successful hiders, they need to learn that an object's opaqueness or transparency is an important feature. Similarly, they need to learn that size is an important feature in terms of getting inside or under or behind an object. They argue that children's understanding of the relationship between these aspects and features of objects is the key to successful hiding. While this position is plausible, it seems likely that some level of perspective-taking ability is present when a child hides successfully from another person. Knowledge about object features may contribute to understanding the perspective of another person, but is unlikely to fully explain successful hiding.

What then are the implications for blind children learning to play hide-and-seek? At this stage, it is helpful to recall Bigelow's (1991b) longitudinal study described in Chapter Five (Section 5.2.1.), in which the hiding abilities of two blind boys, aged six and seven years at the start of the study, two boys with residual vision, aged five and six years at the start of the study, and nine sighted children, aged three to six years at the start of the study, were reported. The children were asked to hide a toy, a specific body part or their whole bodies, and it is the latter that will be considered in this chapter. The children who were totally blind were less able than the children in the other two groups to hide their whole body successfully and by the end of the study, when they were aged seven and nine years respectively, they were still unable to hide themselves completely, frequently simply covering their face, especially the mouth, or curling into a ball and keeping very quiet and still. In contrast, the sighted and partially sighted children typically moved to another room, or hid themselves totally behind furniture. This indicates that the blind children understood that noise or motion could expose them, but did not understand that simply covering a part of their body

left them visually exposed. Bigelow compared the number of partial hidings made by the blind children with those of the sighted children and found that the blind children made significantly more, although the difference between the blind and partially sighted children was not significant. The request 'Make it so that I can't see you' elicited very different responses from the blind children compared to the other children. Initially, the blind children curled into a ball, burying their faces deliberately in their hands or knees, and keeping very quiet and still. At later visits, they started to use alternative strategies, such as hiding beneath a table and then curling up, despite the fact that these positions left them visible to the experimenter. Towards the end of the study, when they were seven and nine years old, they began to move into other rooms, but even then, when the experimenter 'found' them, they often had covered their faces with their hands, or were facing the wall, or had crawled under furniture suggesting that they thought they would not be seen by a person entering the room when they adopted these positions.

The literature on children's ability to take the perspective of another person indicates that they need to grasp four basic concepts which are essential to the development of Level 1 perspective-taking skills: people see with their eyes; eyes see what they are oriented on; obstacles block vision; and one person's view of an object is not necessarily another's (Lempers et al., 1977). Chapters Four and Five elaborated on these concepts, and suggested that understanding them presents blind children with a challenge. Studies 2, 3 and 4 indicated that blind children, at least those aged seven years and over, understand that people see with their eyes, and that they need to be facing towards a visual target in order to see it. They also seem to be aware that an object or person that can be seen by one person will not necessarily be seen by

another person, even if that person is in close proximity. Many also demonstrated that they understood that occluding objects block vision, although this rule seems harder to grasp and there was confusion, for example about whether their own bodies block vision, whether corners block vision, and whether barriers block vision if the viewer and the visual target are in close proximity at either side of a barrier. Previous research has also revealed that blind children have difficulty deciding whether intervening wire mesh screens prevent vision (Nock et al., 2004) and in Bigelow's (1991) study, there was evidence that blind children were confused about how much of a visual target (including their own bodies) needed to be covered by an occluding object in order to be invisible. It seems feasible then to suggest that of the four basic concepts proposed by Lempers et al. (1977), the role of occluding obstacles presents the most difficulty to blind children (possibly because they are less knowledgeable than their sighted peers about object features), and this was evident in Bigelow's (1991b) study of hiding in blind and sighted children.

The importance of taking care when selecting materials and using language has already been discussed at length in Chapters One and Six and Bigelow's methodology provoked some criticism. Specifically, for the purposes of this current study, the main criticism is that the procedures used were rather artificial: the children were simply asked to hide their whole body, a specific body part or a toy, and then were asked after each hiding if the hidden part or object could be seen by the observer. The questions themselves could have easily been misinterpreted as a request to see the child, body part or toy, and it is not possible to say with certainty that the children understood the question sufficiently to respond to it appropriately.

Furthermore, whilst acknowledging the difficulties in recruiting congenitally blind children with no other cognitive or physical impairments, Bigelow had only two blind participants so generalisation was impossible. Additionally, the age-range of the two blind children was limited, precluding the identification of any developmental trend.

An additional issue is that of control. Simply asking children to “Make it so that I can’t see you” seems to be rather arbitrary, with children in different households having access to different types of hiding place, which might put some at a disadvantage.

The impetus for the present study was to investigate the hiding skills of blind children across a broad age-range. Bigelow’s methodology was modified by the provision of a ready-made scenario, in which a variety of hiding places was available. These were selected on the basis that they were either completely appropriate or flawed as hiding places, and attempted to reproduce the types of errors seen in other hiding tasks or visual perspective-taking tasks. The appropriate hiding places were a large cardboard box, a classroom table covered with a sheet that touched the floor on all sides and a large unzipped sleeping bag, in or under which the children could completely conceal themselves. Flawed hiding places were a mask to cover the facial area – a strategy observed in young sighted children (e.g. Flavell, Flavell et al., 1980) as well as in blind children (e.g. Bigelow, 1991b), a mesh fireguard, behind which the children could crouch down completely, but that would leave them visible as the mesh could be seen through. This was included because blind children in Nock et al. (2004) experienced difficulty in predicting whether a wire mesh screen through which they were unable to put their fingers could or could not be seen through. Another flawed

hiding place was an identical table to the one referred to above, but without a covering sheet, which were the children to select as a hiding place, would have left them exposed to the viewer as was observed in Bigelow (1991b). Given the tendency of both blind and young sighted children to believe that they, or another person, cannot be seen when only part of their body is occluded from view (e.g. Bigelow, 1991b; Bridges & Rowles, 1985; McGuigan & Doherty, 2005), a small and a medium sized plastic crate were included in the scenario. The small one was large enough to cover the head completely, while the medium one was large enough to sit in with knees drawn up, but too shallow to conceal the whole body of even the smallest child.

It was hypothesised that the provision of several hiding places within a controlled environment would enable the children to select one of the three locations that was most appropriate (*viz.* the large cardboard box, the covered table or the sleeping bag), thus indicating that despite possible limitations in understanding the effects of barriers upon vision, blind children are able to hide themselves completely when provided with appropriate materials. If however their hiding abilities are as limited as suggested by previous studies (e.g. Bigelow, 1991b), the children would select the hiding place unsystematically, with no preference for the most appropriate locations.

11.2. Method

11.2.1. Participants

Thirteen congenitally blind children participated in the study, all of whom had participated in earlier studies reported in this thesis. They were aged from 3;10 to 11;8 ($M = 99.85$ months, $SD = 28.07$ months). Ten were of White British ethnicity, and

three were of African ethnicity, born in the UK. Further details for the blind children are shown in Table 11.1.

Table 11.1: Details of blind children participating in the Hide-and-Seek task

Child	Age	Cause of blindness	Gender	Level of vision	
				R	L
B	3;10	Septo-optic dysplasia	m	LP	LP
H	4;10	Septo-optic dysplasia	m	none	none
G	6;3	Retinopathy of prematurity	f	none	none
M	7;7	Retinopathy of prematurity	f	low LP	none
D	7;11	Optic Nerve Hypoplasia	f	LP	LP
O	7;11	Retinopathy of prematurity	f	LP	LP
C	8;2	Lebers amaurosis	f	none	none
As	8;11	Lebers amaurosis	m	none	none
Mo	9;6	Retinal dystrophy	m	low LP	low LP
J	10;2	Retinopathy of prematurity	f	LP	LP
S	10;3	Lebers amaurosis	m	LP	none
Se	11;2	Anophthalmia	f	none	none
Be	11;8	Retinopathy of prematurity	m	none	none

(LP = light perception)

All the parents of the blind children in the study had previously signed consent forms (Appendix 2A), but as the children’s performance on this task was to be video recorded, parents were asked to give specific consent to this (Appendix 2D). A letter was sent to the parents, which supplied information about the task. They were asked to sign a consent form only after they had been given time to consider their decision; were informed that they could withdraw from the research at any time; and were assured that should they so wish, any data that they provided would be destroyed and that there would be no resultant adverse consequences (HPMEC, 2006, pp.1-2). (See Section 6.3.2. for detailed information on recruitment and ethical considerations.)

11.2.2. Materials

A 450cm by 450cm square space was demarked, using natural 90° corners where available for two sides, and gymnastic benches or similar for the other two sides.

Eight hiding places were placed within the square. Three were appropriate and they were as follows: a large cardboard box, measuring 88cm by 88cm by 88cm placed with an open end facing the back of the square; a school table 70cm high by 100cm long by 80cm wide, draped with a bed sheet that fell to the floor on all sides; and a large unzipped sleeping-bag. There were five flawed hiding places: an uncovered school table 70cm high by 100cm long by 80cm wide; a wire mesh fireguard measuring 70cm high by 60cm wide, with 5mm apertures; a medium sized opaque plastic storage crate 30cm deep by 40cm wide by 60cm long; a small opaque plastic storage crate 12cm deep by 25cm wide by 36cm long; and a mask, consisting of a paper dinner plate attached to a wooden spoon with sticky tape, which when held in front of the face, completely concealed it. A plan of the layout can be seen in Figure 11.1.

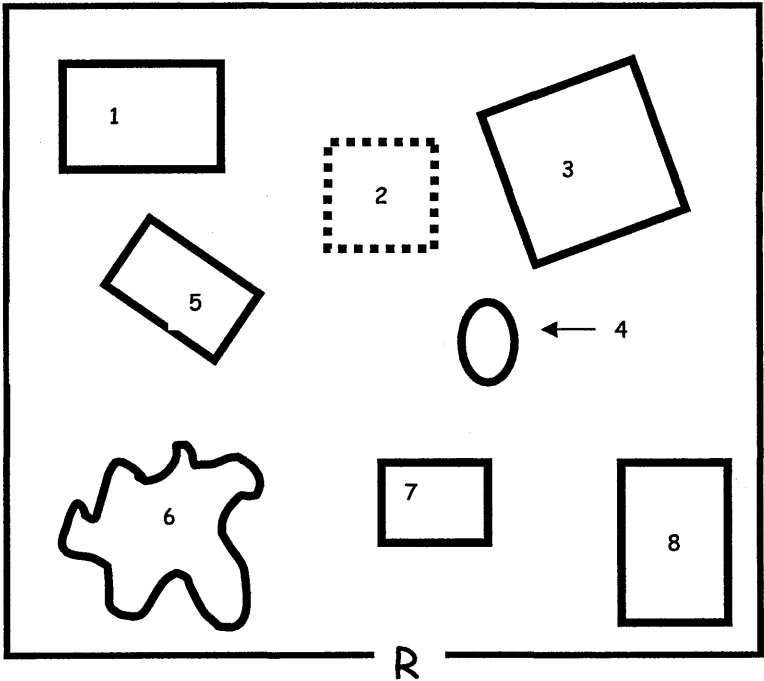


Figure 11.1: Layout for Hide-and-seek task (450mm x 450mm)

- | | | |
|-------------------------|----------------------------------|---------------------------------|
| Key: | | |
| 1 = covered table | 4 = mask | 7 = small plastic storage crate |
| 2 = mesh fireguard | 5 = medium plastic storage crate | 8 = uncovered table |
| 3 = large cardboard box | 6 = sleeping bag | R = researcher's position |

Where possible, a video camera was used to record the children's responses to the task, and their responses were scored on a proforma (Appendix 8) from the videotapes. One parent and one Headteacher refused permission to videotape, and in these cases, the proformae were filled in during and immediately after the task. Access to the video material was restricted to the researcher, and parents were assured that once the information on the video had been written up, the recording would be destroyed in accordance with The UK Data Protection Act (1998).

11.2.3. Procedure

Each child was tested individually on the task, which took place either indoors or outside at the child's school, depending upon available space, weather and convenience to school staff.

The researcher constructed the hide-and-seek scenario before the child was brought to the location. The child was brought to the scene and the researcher asked the child if he/she had ever played a game called hide-and-seek. All the children were able to indicate that they knew and understood the basic concept of the hide-and-seek game, although some children were able to give more complex answers than others, for example, the youngest child (aged 3;10) simply said, "I play with mummy". The researcher prompted him to explain how he and his mother played, and finally he responded, "I have to go where she can't find me". The researcher asked him to give examples of hiding places at home and he identified "behind the settee" and "in the larder cupboard". The child aged 10;2 was able to give a comprehensive account of the rules of hide-and-seek, and explained that she plays frequently with her sighted

siblings. She also named ideal hiding places at home, for example, “behind the curtains”.

Once it had been established that the child had an at least rudimentary understanding of the game, the researcher explained that she had prepared a game of hide-and-seek and had brought some objects that could be used as hiding places. There then followed a familiarisation period in which the child was introduced to the scenario.

The researcher and child walked through the scenario, first exploring its boundaries. The researcher explained that the child should not go outside of those boundaries to hide. She then said that there were lots of hiding places to choose from and the hiding locations were introduced by walking around them slowly starting at the researcher’s position (R on Figure 11.1) in the following order: uncovered table; mask; large cardboard box; mesh fireguard; covered table; medium plastic storage crate; sleeping bag; small plastic storage crate. The child was given sufficient time to explore the objects, and in addition, the researcher gave a verbal description of each one, for example, *“This is a table, and there’s a sheet over it. Can you feel that? Can you feel where the sheet goes?”* After the child and researcher had walked around the scenario once, the researcher invited the child to explore the scenario again, saying *“Have a good look at the hiding places and try to remember where they are”*. The child was allowed as much time as needed to familiarise him- or herself with the hiding places.

If a child became disoriented, the researcher brought her/him back to the starting point (R) and the child started again. No time pressure was put on the child, and all questions were answered, without giving any clues as to the appropriateness of the

locations as hiding places. No questions were asked about the nature (e.g. transparency) of the materials.

At the end of the familiarisation period, for the children who were to be recorded, the child was shown the video recorder and told that the next bit of the game was going to be recorded. The researcher then said, *“In a minute, I’m going to ask you to hide. I’m going to turn my back, like this (demonstrate) so that I can’t see what you do or where you go. You should hide in the best place you can, so that I can’t see you at all, not any part of you. Mrs ... (adult helper) is going to video you while you’re hiding, and we shouldn’t be able to see you at all on the film, once you’re hidden. When you call ‘I’m ready’ I’ll come and try to find you. Do you understand?”*

For the children who were not being video-recorded, the researcher said, *“In a minute, I’m going to ask you to hide. I’m going to turn my back, like this (demonstrate) so that I can’t see what you do or where you go. You should hide in the best place you can, so that I can’t see you at all, not any part of you. When you call ‘I’m ready’ I’ll come and try to find you. Do you understand?”*

Once the child was judged to understand, the researcher took him/her to the starting point (R), and said, *“I’ll turn my back now and off you go when you’re ready”* or if they needed further explanation, the instructions were repeated.

Some children asked the researcher to count aloud while they hid, saying for example that they did that when they played at home or that counting was part of the rules. The researcher responded by counting, but no upper limit was placed on the counting as

this might have caused the children to rush and increased the chance of either random choosing of hiding location or disorientation. If this was questioned the researcher said that they could have as long as they needed in this game and all the children accepted this without question.

The child indicated that he/she was hidden by calling 'I'm ready' or similar, and the researcher then went to 'find' him/her, pretending to look in several places, regardless of whether the child was fully hidden or not in order to affirm the child's efforts and ensure enjoyment of the task. The researcher praised the child, commending the attempt that he/she had made to find a good hiding place.

The researcher then asked the child to return to his or her hiding place and asked: "*When you hid, could I see any part of you?*" In the event, all children said that no part of them was visible to the researcher. The researcher then asked the children to explain why they had chosen that particular location.

11.2.4. Scoring

The children were given a status of 'hidden', 'partially hidden' or 'not hidden'.

11.3. Results

The majority of the children clearly knew about hiding, and even the three youngest hid successfully ($M = 1.69$, $SD = 0.63$). Individual scores are presented in Table 11.2.

Table 11.2: Age, hiding places and and hiding status of the blind children in the Hide-and-Seek task

Child	Age	Hiding place	Hiding status
B	3;10	large cardboard box	hidden
H	4;10	large cardboard box	hidden
G	6;3	large cardboard box	hidden
M	7;7	under tree *	not hidden
D	7;11	large cardboard box	hidden
O	7;11	large cardboard box	partially hidden
C	8;2	table	partially hidden
As	8;11	covered table	hidden
Mo	9;6	covered table	hidden
J	10;2	covered table	hidden
S	10;3	sleeping bag	hidden
Se	11;2	covered table	hidden
Be	11;8	covered table	hidden

* not in scenario, but selected spontaneously by child

There was a dip in the middle of the age-range, with one child not hiding at all and two children only achieving partial hidings. The majority of the children hid either under the covered table (1) or in the large cardboard box (3), although one child hid under the sleeping bag, one under the uncovered table and one child did not hide at all.

More children chose appropriate hiding places (*viz.* the large cardboard box, the covered table or the sleeping bag), than would be expected by chance ($t = 11.078$, $df = 12$, $p < 0.001$), supporting the hypothesis that blind children are able to hide themselves completely when provided with appropriate materials.

An additional observation was that the five children who hid in the large cardboard box were significantly younger than the five who hid under the covered table (Mann-Whitney $U = 0.0$, exact $p = 0.008$). This will be explored in Section 11.4.

The hiding places of the children who failed to hide totally were then considered in more detail. Of the 13 children, only three failed to hide themselves totally, with two achieving partial hidings and one remaining completely visible. The one who was not hidden at all (aged 7;7) initially seemed to experience considerable difficulty finding her way around the scenario, which was set up in the school playground. Eventually, she moved outside of the parameters of the task materials, apparently accidentally, although she had explored a number of hiding locations before this happened. She was encouraged to return to the starting position, which she did, but again moved outside of the parameters. Her behaviour appeared to be purposeful rather than accidental as it had initially appeared, so the researcher allowed her to continue without interruption. The child moved outside the boundary slipping between the two gymnastic benches that were placed at right angles just beyond the large cardboard box. She stood very still and tilted her face toward the sky for a few seconds, then called, "I'm ready". The researcher asked if she was hidden and the child said she was. The researcher 'found' the child and then asked her why she had gone outside of the scenario, to which the child replied that she had found a better hiding place on her own. When asked to elaborate, she explained as follows: "I moved into the shade under the tree. You couldn't see no part of me because I was hidden. I know I was hidden because it felt dark under the tree. It felt dark to my eyes." This will be discussed further in Section 11.4.

Two children achieved partial hidings. One (aged 7;11) chose an appropriate location but failed to hide properly. She chose the large cardboard box, but instead of getting completely inside it, or crouching down behind it so that she was completely hidden, she knelt down behind it with her head still clearly visible to anyone standing at the other side of the box. When asked if any part of her was visible, she said that no part of her could be seen, and when asked why she had chosen that particular location, she replied, "Because the box was in front of me."

The second child (aged 8;2) who was partially hidden crouched under the uncovered table, so was still largely visible from the starting position where the researcher stood. When asked if any part of her could be seen, she replied, "No, when you're under a thing, you're hidden." When asked why she had chosen that place to hide, she replied in similar fashion, "When I was under it, you couldn't see me under it."

The responses of the remaining ten children were then considered. Of the four who hid successfully in the box, only the oldest (aged 7;11) was able to explain how the box had hidden her when she said, "When I was inside, I knew you couldn't see me because the box was all around me and over me ... on top of me". The younger children simply gave descriptive answers, such as "I was hiding ... hide-and-seek" (aged 3;10).

The responses of the children who had hidden under the covered table were much more elaborate, probably because these children were significantly older than the ones who had chosen the box. Generally their responses contained references to sheets not being transparent (three references), showing an awareness of the object property of

transparency/opaqueness, and the sheets touching the floor so that there was no space or gap to see through or under (four references) and three of the comments made reference to both of these factors. A typical example was: “I knew because the table was on top and the sheet went right down to the floor all around. There was no space for you to see me ... I was all covered and hidden. Your eyes were blocked from the sheet and from the table” (aged 10;2). One child (11;8), though, was unable to explain and simply said, “I chose the table because I was *sure* that you wouldn’t see me there.” When pressed, he stated, “You just couldn’t. I knew.”

11.4. Discussion

The performance of the blind children on the Hide-and-seek task shows a marked difference from the children in Bigelow’s (1991b) study, and supports the hypothesis that blind children are able to hide themselves completely when provided with appropriate materials. Unlike Bigelow’s participants, none of the children in this current study attempted to hide by simply covering their whole face or part of their face, nor did they attempt to curl into a ball. Only two children covered themselves partially. The child who hid under the uncovered table demonstrated similar hiding strategies to Bigelow’s children, who, during the course of the study (although Bigelow does not report at precisely what age) tried to hide themselves under tables. The child explained her choice of hiding place by saying, “When you’re under a thing, you’re hidden” suggesting that she was over-generalising from an heuristic that in some circumstances is accurate, but that cannot be applied to all situations.

It seems from the hiding behaviour of the second partial hider, who left her head exposed when she hid behind the large cardboard box, that she did not understand that

the whole of her body needed to be blocked by an occluding object to render her invisible to the researcher. This was in direct contrast to the blind children in Bigelow's study, who, when they achieved partial hidings, tended to hide their faces when attempting to hide. Similarly, two of the youngest sighted children in Bigelow's study (mean age 3.79 years at the start of the study) attempted to hide head first under furniture under which their entire bodies would not fit. This suggests that they believed that if their head and face were hidden, then they could not be seen. This is in line with previous findings that young children associate 'you' with the facial region (e.g. Flavell, Shipstead et al., 1980), so when requested to 'make it so that I can't see you' hide their faces and particularly their eyes. The blind children in Bigelow's study still tended to cover their faces even when they used more appropriate hiding places such as under furniture or in another room, supporting the notion that they associated self-exposure particularly within the facial region. This was not observed in the blind children in this current study. The hiding behaviour of the blind child in this current study who left her head exposed, however, is more difficult to explain, and contrasts with previous findings with both blind and sighted children. In addition to the studies of Bigelow (1991b) and Flavell et al. (1980) discussed above, McGuigan and Doherty (2005) found that for young sighted children aged two and three years, the visibility of a person's face is a key criterion for judging whether or not they are visible, but that the visibility of legs is not.

It is only possible to speculate that the child who left her face and head exposed in this current study was, like the child who hid under the uncovered table, using an heuristic that when a person or object is behind an opaque barrier, such as a cardboard box, then they cannot be seen. This is supported by the explanation she gave when

asked why she had chosen that place to hide: “Because the box was in front of me.” Lack of object knowledge, or lack of knowledge about the amount of space her own body extended into, may also have contributed to her performance; she did not seem to take into account that the size of the box would not block her whole body from view.

A similar inaccurate interpretation of a visual rule may also provide an explanation of the behaviour of the child who went beyond the parameters of the hide-and-seek scenario and ‘hid’ in the shadow of a tree. This behaviour, coupled with her comment that ‘I moved into the shade under the tree’ suggests two flaws in understanding of visual rules: first, that she believed that shade or shadow implies complete darkness, and second, that to move within shade or shadow renders a person invisible. This child has low light perception in one eye, and for her, it is possible that there are only two conditions, light and dark. It is unsurprising then that she is unaware of the variability of the levels of light that sighted people experience, and may apply the general heuristic that you can’t see in the dark to any situation where her own level of vision cannot detect light.

It is difficult to explain why the majority of the younger children hid in the large box, while the majority of the older children hid under the covered table. It is possible to speculate that the older children were aware that even when the researcher went close to the table, as long as they stayed still and quiet, they would remain undiscovered, and the researcher would have to move the sheet in order to find them. By contrast, although the opening of the box was facing away from the researcher’s starting point, when she walked to the back of the box, and crouched down, the child within would

be visible. Thus, although the children who chose the box as a hiding place performed the immediate task successfully, the children under the covered table and also the child under the sleeping bag, may have been thinking beyond the researcher's static position to the point where she would start to search actively for them. One child (8;11) commented spontaneously that although he liked the large box, he did not choose it because he was not sure if he could fit in it (demonstrating that he was aware that the object property of size was important for hiding) and also, he thought that getting into it would make a "rustling noise" which would give the researcher a clue as to where he was, while moving the sheet to get under the table would not make a sound.

All the children who went under the covered table took care to ensure that they were completely hidden. They checked that the sheet was touching the floor on all sides and curled into a small shape before they indicated that they were hidden. The child who hid under the sleeping bag also made sure that the sleeping bag was completely covering him and lay flat on the floor, presumably understanding that the shape of his body would be visible to the researcher through the sleeping bag. All these children kept still and silent once they had called that they were ready, indicating that they understood that even though they were hidden, sound and movement could reveal their whereabouts to the researcher.

A number of spontaneous comments from the children suggested that they understood the limits of the inappropriate hiding places. For example, three children (aged 3;10, 8;11, and 11;2) made comments about the unsuitability of the mask as a hiding place because it only covers the face. The youngest child laughed when the researcher

showed him the mask and said, "I can't hide in that ... only my face can hide." Again, this is in contrast to earlier findings (e.g. Bigelow, 1991b) where blind children hid their faces and particularly their mouths when asked to hide themselves. The child aged 8;11 said that behind the grid was a "rubbish place" because the researcher "would easily see through the holes."

An additional point of interest is that most of the children seemed to have planned where they were going to hide before they set out to find a place, and in fact, several of them, when exploring the scenario, said that they were ready to hide because they had "chosen" or "decided". When the researcher gave the instruction to hide, they tended to move deliberately toward their chosen location, suggesting that they didn't simply stumble across a possible place, but were purposeful in their choice. After the child who hid under the sleeping bag had been 'found' he said that he would have liked to go in the big box, but that he knew he could get completely hidden under the sleeping bag as that was near, he wouldn't run the risk of "getting lost" and not being able to find a good place.

These findings offer an alternative view from those of other studies of blind children's hiding abilities, and contrast sharply with Bigelow's (1991b) conclusion that:

... blind children associate hiding with being in contact with an obstacle, most often their own hands, perhaps because their hands are so available; but they do not readily understand that the covering obstacle has to totally block the view of what is hidden. (p.308).

On the contrary, ten of the 13 blind children in this current study hid successfully, and the strategies that they used to do this (e.g. mentally selecting a hiding place while exploring the scenario, and remembering the location of that place once the game started), and the spontaneous and elicited comments that they made about the

suitability or unsuitability of the available hiding places, suggest that these blind children at least, had a competent understanding of what it means to be completely hidden from the view of another person.

The three children who did not hide successfully, nevertheless demonstrated that they had some understanding about the effects of occluding barriers and darkness. However, their understanding was limited, and they tended to use available heuristics in order to make decisions.

Thus far, the empirical studies have presented an interesting picture that suggests that blind children do in fact have a wealth of information about vision, and have an extensive vocabulary for vision. They also hold similar opinions to those of their sighted peers about factors that affect vision, and have common areas of misunderstanding. Despite this knowledge, they frequently perform at lower levels than their sighted peers on visual perspective-taking tasks, suggesting that their knowledge is declarative, rather than procedural; that is, they *know about* vision, but find it problematic to *put that knowledge into practice*. However, when provided with appropriate materials, and given the opportunity to explore a range of options, blind children are able to demonstrate that they can succeed on a complex task that is thought to reflect their ability to infer what is seen by another, *viz.* hiding themselves from the sight of another (Flavell et al., 1978). This is no mean achievement, and the challenges entailed in the task were encapsulated by seven-year-old D, when she remarked, “This is a bit difficult for me you know, ‘cos I’m not sure about what you can see sometimes!”

Having established that blind children have a good understanding of visual concepts and are able to perform at higher levels than would be expected by chance on visual-perspective taking tasks, the question remains as to how they are able to achieve this understanding without the experience of vision. The final empirical study sought the views of parents and educators of congenitally blind children on this subject.

CHAPTER TWELVE

STUDY 6: THE VIEWS OF PARENTS AND EDUCATORS OF CONGENITALLY BLIND CHILDREN ABOUT BLIND CHILDREN'S UNDERSTANDING OF VISION

12.1. Introduction

The evidence from the five empirical studies reported so far in this thesis supports Carey's (2002) position that blind children can and do acquire a language of vision and have a rich understanding of visual concepts. Whilst their knowledge and understanding is not always accurate and appears to be declarative rather than procedural in nature, i.e. they know about vision, and can identify factors that affect vision, but find it problematic to put their knowledge into practice, they nevertheless demonstrate clearly from an early age that they are able to take the perspective of a sighted person in some situations, and are able to discuss and explain visual concepts with some accuracy.

In addition to the findings from the empirical studies reported in this thesis, previous research has also provided persuasive evidence that blind children are able to use visual terms fluently, accurately and appropriately to describe visual concepts and the concrete visual experiences of sighted people. They also use terms such as 'see' and 'look' to refer to other sensory ways of perceiving (e.g. Brown & Bellugi, 1964; Landau & Gleitman, 1985) and use them to describe their own perceptual experiences. Furthermore, blind children understand that sighted people see things differently from the way that they do, and do not confuse touch or hearing with vision (Brambring, 2005; Landau & Gleitman, 1985) (see Chapter Five).

One area of visual language that may be particularly difficult for blind children to grasp is the use and meaning of colour terms (Landau & Gleitman, 1985), although they can differentiate between colour (e.g. yellow) and non-colour (e.g. loud) adjectives by the age of five years. Carey (2002) argues that congenitally blind children need to be taught explicitly about visual concepts, in particular colour, and he advocates the use of ‘special means’ to deliver this teaching. Although there was evidence that the blind children who participated in the five empirical studies reported in this thesis used visual terms with fluency, it is unclear how they learnt to do so. Have they been exposed to ‘special means’ or have they simply learnt about vision and visual language spontaneously? The final empirical study aimed to explore this question, using a semi-structured interview to elicit the views of parents and educators of congenitally blind children in order to identify what might be termed as ‘special means’ and to consider the contribution of these, if indeed any were identified, to the development of blind children’s knowledge and language of vision. The contribution of incidental, naturally occurring situations and experiences was also explored.

Parents and educators were interviewed (see 12.2.2. to 12.2.4. below) about the following six broad themes:

1. *How do blind children demonstrate an understanding of vision through their language and behaviour?* (Question (Q)1 to Q6).

The aim of the first theme was to discover whether the parents and educators of blind children are able to provide naturalistic evidence of blind children’s understanding of vision through examples of language and behaviour.

2. *Why is it important for children who are blind to develop an understanding of vision and seeing? (Q7).*

It was argued in Chapter One (Section 1.1) that understanding about vision is related to, and instrumental in, many areas of cognitive and social development. It is a key element in the development of: perspective-taking (Flavell, 1978; Flavell et al., 1968); understanding about the aspectuality of knowledge (Dretske, 1969; Perner, 1991); theory of mind (Astington, 1993; Gopnik et al., 1994); knowledge of 'self' (Bischof-Kohler, 1991; Flavell, Shipstead et al., 1980); knowledge about self-exposure and visibility to others (Flavell et al., 1978); proficient use and understanding of the language of vision (Carey, 2002); language (Fraiberg, 1977); motor skills (Hatton et al., 1997); spatial awareness and understanding (Lewis et al., 2004); and symbolic play (Andersen et al., 1984). There is little doubt then, that research in developmental psychology indicates that it is beneficial for blind children to understand about vision. What is less clear is whether parents and educators agree with this, and if they do, what reasons they can give to explain their beliefs.

3. *What explicit activities or 'special means' do parents and teachers of congenitally blind children use in order to develop and extend blind children's knowledge about vision? (Q8 and Q11).*

Theme 3 was aimed at discovering whether any parents or educators of congenitally blind children employ what might be termed 'special means' in order to facilitate the development of children's understanding of vision, and if so, to identify and describe those activities.

4. *What naturally occurring events facilitate blind children's knowledge about vision? (Q9 and Q10).*

The comments of the blind children reported in this thesis thus far, suggest that they often pick up information about vision through incidental conversation. (See, for example, Sections 9.4.2. and 9.4.3.). Theme 4 aimed to supplement what has already been documented, and to explore how parents and educators perceive the effects of naturally occurring events, and whether they exploit those events in order to facilitate the development of blind children's understanding about vision.

5. *Does perceptual experience in the other sensory modalities help or hinder blind children's development of knowledge about vision? (Q12).*

Some of the blind children who participated in the Understanding Hearing and Understanding Vision tasks (Chapter Eight) may have been using the rules of the auditory modality in order to make predictions about whether they could or could not be seen by an observer (Section 8.3.1.; Table 8.7.). When the perceptual rules are similar, for example, sounds and aromas can both travel around corners, reasoning of this type is useful. If however the perceptual rule differs, for example, sounds travel around corners but the line of sight does not, then applying the rules of the other modality can lead to errors of judgement. Although this is an area considered by psychologists, there is no available information about the views or experiences of parents and educators of blind children, and Theme 5 aimed to explore this topic.

6. *Does the current education system in England and Wales promote blind children's understanding of vision, and are there any ways in which this could be improved or developed? (Q13).*

The language that the blind children used when explaining why they considered some factors more important for vision than others in the Ranking task (Chapter Nine) often suggested that they were drawing upon scientific knowledge gained in the classroom. Theme 6 aimed to elicit the opinions of educators about the effectiveness for blind children of the National Curriculum (DfEE, 2000).

Interviewees were asked to relate specific examples to illustrate their responses. The study aimed to elicit some insight into how congenitally blind children develop their understanding of visual concepts and language.

12.2. Method

12.2.1. Participants

A total of 23 parents and educators of the blind children who took part in Studies 1 to 5 participated in the interviews. A letter was sent to all the parents and educators, which supplied information about the interview and what participation would involve (Appendix 2E). They were asked to sign a consent form only after they had been given time to consider their decision; were informed that they could withdraw from the research at any time; and were assured that should they so wish, any data that they provided would be destroyed and that there would be no resultant adverse consequences (HPMEC, 2006, pp.1-2). They were also informed that the audio recordings would be destroyed once the interviews had been transcribed, in accordance with The UK Data Protection Act (1998).

Twelve parents, seven teachers and four classroom assistants (11 educators in total) agreed to participate in the study. In seven cases both a parent and an educator were

interviewed about one child; in four cases, only an educator was interviewed; and in three cases, only a parent was interviewed. In one case, both parents of one child were interviewed, and as they were always in agreement in response to the questions, their responses are counted as one.

12.2.2. Design

The views of parents and educators were investigated through the use of a semi-structured interview. The interview method is not free from pitfalls, for example, gathering and analysing interview data can be time-consuming, interviews are subject to researcher bias and subjectivism (Breakwell, 1995), and participant and researcher reactivity may affect the reliability and validity of the data (Punch, 1998) (see Chapter Six, Section 6.6.2. for a full discussion of this issue). Nevertheless, interviews can permit in-depth exploration of complex issues and allow the researcher "...to follow up ideas, probe responses and investigate motives and feelings which the questionnaire can never do" (Bell, 2001, p. 135). Thus, in the final study, a semi-structured interview was used in order to collect data that would provide insights into the perceptions of parents and educators, allowing the interviewer to explore ideas and avenues that were raised not only by the questions on the interview prompt sheet, but also those that were raised by the interviewees. It was hoped that this approach would be useful to explore how congenitally blind children develop knowledge and understanding of vision through formal and informal interaction with peers, siblings, educators and parents.

An accurate record of the interview data was produced, which sought to represent faithfully the participants' perspectives by referring, as far as possible, to the actual words they used and the particular ways they expressed themselves (Uzzell, 1995).

12.2.3. Materials

The researcher used an interview prompt sheet containing questions that were structured around the six themes outlined in Section 12.1 (Appendix 9). The questions appear in full in Section 12.3. The questions for parents and educators were identical except that an additional question relating to the National Curriculum in England and Wales was asked of the educators. Thus, there were 12 questions for the parents and 13 for the educators. The interviews were audio-recorded using a small tape-recorder in order to free the researcher from the need to take notes whilst talking to the interviewees and to facilitate listening carefully to their responses. Access to the audio material was restricted to the researcher in accordance with The UK Data Protection Act (1998).

12.2.4. Procedure

The interview was piloted on a teacher of visually impaired children in order to clarify the questions, check that the researcher was adopting good listening skills and to ensure that the interview would not last too long (each interview took no longer than 45 minutes). The interviews were conducted face-to-face in a conversational manner. Although the interviews were 'structured', in that they involved a fixed set of questions asked in a fixed order (Breakwell, 1995), a semi-structured approach was adopted, and care was taken to assume a relaxed manner so as to put the interviewees at ease and to enable them to feel free to offer as much information as they felt was

appropriate. The researcher explained the purpose of the interview to the participants, and asked their permission to audio-record the proceedings, which would be transcribed later. There was no limit upon the number of examples or comments that an interviewee could make to the questions. The educators were interviewed in the schools where they worked. Parents were usually interviewed in their homes, but on two occasions, parents asked to be interviewed at their child's school. Most interviews were conducted on an individual basis, but in one case, both of the child's parents wanted to be interviewed, and therefore a joint interview was conducted.

12.2.5. Data analysis

The data elicited from the interviews were rich and varied, and the analysis was strongly influenced by the approach of Miles and Huberman (1994). First, the interviews were transcribed in full, except for irrelevant utterances. The data were then coded for the particular themes and topics under investigation in order to condense the information and make it more manageable. Also, care was taken not to lose information in the process, nor to strip the data from their context (Punch, 1998). Each question was addressed systematically, and descriptive labels were assigned to each chunk (piece, which may be an individual word or short phrase) of data. When this stage had been completed, two independent raters were asked to suggest alternative labels if appropriate. In the event, both raters expressed agreement with the original labels assigned by the researcher. The chunks of data were then assigned to the descriptive categories and in order to ensure the reliability of the researcher's coding of responses, 25 per cent of the responses were independently categorised by another rater. Inter-rater agreement, calculated by dividing the number of identical allocations by the total number of allocations, was .95.

12.3. Results and discussion

The results will be summarised and discussed question by question, and where a parent and an educator were interviewed about the same child, comparisons will be drawn between their responses if appropriate. Both of the parents of one child (Ma aged 13;5) were interviewed, and they were always in agreement about the responses to the questions. When age is considered to be a relevant factor, this will be discussed. Links between the adults' views of the children's understanding of vision and how the children performed in the empirical studies reported in this thesis will be commented on in Section 12.4.

Question (Q) 1: What do you think that [insert child’s name] (C) understands about what sighted people mean by ‘seeing/vision’? Can you give some examples of things he/she has said or done that lead you to think this?

Seven response categories emerged from the responses to the first question (Table 12.1).

Table 12.1: No. of responses from parents and educators to Q1, by response category

Response category	Parents	Educators
Knows it's different from self	7	5
Same as touching/hearing	2	1
Aware that sighted people can see texture/depth	1	0
Knows that sighted people see the 'whole picture'	1	0
Knows that sighted people see a range of things simultaneously - more than is possible through touch	2	1
Knows that sighted people see further	1	1
Respondent isn't sure of what child understands	1	3

There was a strong similarity between the parents’ and educators’ views about what the children understood. In five of the seven cases where both were interviewed about the same child, there was agreement about what the child understood by ‘seeing’ and ‘vision’. In the cases where they differed, educators said that they were unsure about

the child's understanding, while the parent said in the case of B (3;10) that he thought of seeing in terms of touch, while the parent of A (8;11) said that he knew that sighted people see differently from him.

Responses to the question were mainly bound up with the blind children's perceived difference between how they 'see' and how sighted people see, and both parents and educators referred to this. Take, for example, the parent of C, (8;2):

EXTRACT (E) 1

"Experiencing something ... different to her way of seeing, and understands that you can see things that you can't hear or touch ..."

Or, the teacher of Mo (9;6):

E2

"... he doesn't always understand whether things can be seen or not. He does know that trees can be seen from the windows in school, because I told him in the autumn that I could see the leaves blowing off from them. He asked me if I could see them from here and we had a long discussion about windows and transparency and distance... you know, those things provide great opportunities for talking about vision. He realises that sighted people experience the world itself differently to him, but I don't know how deep his understanding can be with him never having seen at all."

Many of the comments indicated that some children, particularly the older ones, understood that the visual modality provides rich and complex information to the viewer, and the parent of Ma (13;5) spoke of this when she said:

E3

“He knows that we [sighted people] can see depth and texture. He knows that we can see the whole picture and not just isolated parts of the picture. He asks us about size and colour, or texture and depth of things, because he knows that we can usually tell all that sort of thing just from looking, and even from a distance.”

The two youngest children (B, 3;10 and H, 4;10) though, were believed to have no understanding at all of what sighted people mean by ‘seeing’:

E4

“He thinks that we see in the same way as him. He’s not conscious at all of any difference.” (Teacher (T) of H, 4;10).

Some interviewees were unsure of how to respond to the question and the following extract illustrates the difficulties that people who live and work with blind children experience when trying to gauge their understanding:

E5

“I’m just not sure. O asks questions about what people are wearing so she knows that seeing gives information that she can’t get independently. What her mum’s explained to her. But honestly, I don’t really know.”
(Classroom Assistant (CA) of O, 7;11).

In summary, responses to Q1 were rich and varied, mainly focused on blind children’s understanding that sighted people ‘see’ differently than they do. Responses suggested that most of the children had grasped this basic concept, but in the case of

the two youngest children, the interviewees believed that they had no comprehension at all about what sighted people mean by seeing and vision.

Q2: Does C understand that sighted people don't need to touch things in order to see them? Can you give some examples of things he/she has said or done that lead you to think this?

Ten of the 12 parents and ten of the 11 educators interviewed expressed the belief that the children understood that sighted people can see things without touching them, and only the parents of the two youngest children (B, 3;10 and H, 4;10) and the teacher of H (4.10) stated that the children did not understand that sighted people do not need to touch things in order to see them. Thus, children aged 6;3 and above were judged to understand that vision is possible without touch. The following extracts illustrate some of the evidence they gave to support their beliefs:

E6

"When I take her out to meet her mum at the end of the day, she often asks me what her mum's wearing." (CA of O, 7;11).

E7

"... she asks when we're at the bus stop, 'Is that our bus coming, has it got our number on it?' She definitely understands that we can see without touching." (Parent (P) of D, 7;11).

Two teachers (of H, 4;10 and M, 7;7) believed that the child understood the concept implicitly, but they were not sure of the child's level of understanding. The mother of H, though, was of the opinion that he had no awareness of the notion at all:

E8

"No, he doesn't understand that at all. You know, when we show him something, we have him touch it, and obviously, we're touching it at the same time as we hold it and help him to run his hands over it ... we say, 'Look H, look at this' and I haven't thought about it before, but that's gonna be confusing isn't it?"

Apart from this one discrepancy of opinion, where both a parent and an educator were interviewed about the same child, they were in agreement about that child's understanding that vision is possible without touch.

In summary, all but the youngest two children were thought to understand that sighted people can see without touching things or objects, and both parents and educators were able to supply examples of comments and behaviour to support their beliefs about the children's understanding of this concept.

Q3: Does C ever use vision related language, e.g. talking about colour, light/dark/shadow etc. If so, what do you think this term means to C?

Even before this question was put to the interviewees, there had been numerous references in the comments they made that referred to blind children's use of vision related language as can be seen in some of the extracts above. The following examples give some idea of the range of terms that the participants had heard the children using:

E9

"We use 'see', 'look' and 'watch' to him, and he uses them too. He asks for his blue car... and now he says, 'Let's put the light on, it's dark when we get home.'" (P of H, 4;10).

E10

“Se said to me ‘You and Mrs P. are always wearing the same colours aren’t you? I said ‘How on earth do you know that?’ ‘Well’, she said, ‘I always ask all of my teachers what colours they have on today, and you and Mrs P nearly always have brown and yellow and orange.’... We had a long chat then about colour and fashion.” (CA of Se, 11;2).

These extracts represent only a small selection of the many and varied comments offered by both parents and educators alike. This use of visual language had surprised the mother of one young blind child, who stated that:

E11

“We never used colour words to him when he was little. We didn’t think they’d be relevant, but when he began to use them, we realised that he needs to ... wants to know.” (P of B, 3;10).

The conviction that blind children do need to be familiar with and conversant in the language of vision was evident in the participant’s responses throughout, and although the issue was addressed directly by Q7, several responses to Q3 contained reference to this. Thirty-six per cent of the parents (but interestingly, no educators) reported that their children expressed their need to look attractive to their peers through the use of visual terms:

E12

“Colour coordination is very important to him now. He wants to look smart, nice, trendy. To fit in with his friends, and maybe to impress the girls!” (P of Ma, 13;5).

E13

“Oh, she’s ‘Does my hair look nice? Are these earrings matching with my ring? Do silver and pink look cool?’” (P of Se, 11;2).

These children were towards the top end of the age-range and probably in the stage of puberty, at an age where it might be expected that children would be particularly concerned about their appearance out of desire to fit in with their peer group, and also, as Ma’s parent commented, to attract the opposite sex (Durkin, 1995).

Q3 elicited a rich mixture of responses, which indicated that all the children whose parents and/or educators participated in the study used the language of vision frequently and spontaneously. All the participants reported that the children used colour terms, light and dark terms and general verbs such as ‘look’, ‘see’ and ‘watch’.

Q4: Does C ever hide from you or other people? If yes, describe situations, and describe how well hidden C was.

In the cases of those parents and educators interviewed about the same child, three children (D, 7;11, J, 10;2 and Se, 11;2) had been observed hiding from people while a further two (H , 4;10 and A, 8;11) were reported never to have been seen to engage in hiding games. The reports about the observed behaviour of Mo (9;6) differed. He had been observed hiding at home but not at school. Where only the parent or the educator was interviewed, six more children had been observed hiding. The responses fell into three categories, shown in Table 12.2.

Table 12.2: No. of responses from parents and educators to Q4, by response category

Response category	Parents	Educators
Yes, usually hides successfully	4	4
Yes, but usually leaves some body-part exposed	3	3
No, never hides	4	4

The parent and educator of J (10;2) agreed that she was a competent hider, but reports about the ability of Se (11;2) differed. The classroom assistant described her efforts as ‘brilliant’, while her mother said that it was ‘a bit hit-and-miss’. Typical examples of observed hiding behaviour are given below:

E14

“Yes, he plays hide-and-seek with his sister, and he’s brilliant! It’s really hard to find him ‘cos he understands about covering up all of his body and keeping still and quiet.” (P of Mo, 9;6).

Some interviewees said that sometimes the children hid well, but more often than not, left parts of themselves visible:

E15

“She has a ‘Wendy House’ in the garden and she knows we can’t see her if she’s in there. But if she’s just trying to hide, maybe from me or from her brother, she’s not very good. She might go head-first under her bed, but her feet or even most of her body are left sticking out... No ... she’s not good at it, but she still likes to have a go.’ (P. of C, 8;2).

This type of behaviour is reminiscent of the hiding attempts of the blind boys described in Bigelow (1991b), who curled up into balls, or of the younger, sighted children in the same study, who ‘tried to hide (head first) under furniture under which their entire bodies would not fit’ (Bigelow, 1991b, p. 307). The teacher quoted below also describes behaviour similar to the blind children in Bigelow (1991b):

E16

“Not spontaneously, but in directed play he joins in hide-and-seek ... makes himself as small as he can, but usually leaves some showing.” (T of B, 3;10).

The similarity to younger, sighted children's hiding behaviours was noted by one of the interviewees:

E17

"...she always leaves something showing, y'know, like younger sighted kids." (CA of O, 7;11).

One parent gave an account of how her child's hiding skills were improving:

E18

"She doesn't often hide spontaneously, but when she does, she usually does it properly... She hid in the coat cupboard at her Granny's one day and frightened us all to death! ... It wasn't funny at the time, but we've laughed since. I think she began to think then that she had to be totally inside something to not be seen, so she goes like, under the slide and says 'I'm not hidden am I?' whereas last year at this time, she'd think she was hidden if there was something over the top of her. She still sometimes makes mistakes and you might see her hand or a foot, or the top of her head, but she's getting the hang of it now." (P of D, 7;11).

This is a particularly interesting comment because it may provide an example of how a spontaneous action led to new learning for the child, which she continues to test out, by hiding in inappropriate places and asking for confirmation that she is still visible. It may also shed some insight into why all the children who hid appropriately in the Hide-and-Seek task (Chapter Eleven) chose enclosed spaces (under the covered table and inside the big box) rather than simply crouching down behind those objects. Possibly, they have experienced more successful hiding when inside, rather than behind, an object.

These extracts reveal a broad range of observed self-hiding proficiency in the blind children. As a point of interest, only four children had never been observed trying to hide themselves: H (4;10); M (7;7); A (8;11) and E (11;0). The remaining children then, across the age-range, whilst not necessarily proficient at hiding themselves, nevertheless engage in behaviours that indicate they understand something about hiding from the view of sighted people. The following question explored their abilities when hiding objects.

Q5: Does C ever hide objects from you? If yes, describe situations, and describe how well hidden the object was.

Responses to this question were categorised in the same way as the responses to Q4, with reference to how well, if at all, the children were able to hide objects. The responses are summarised in Table 12.3.

Table 12.3: No. of responses from parents and educators to Q5, by response category

Response category	Parents	Educators
Yes, usually hides objects successfully	8	4
Yes, but usually leaves some part exposed	0	1
No, never hides objects	3	6

Of the seven children whose behaviour was commented upon by both a parent and an educator, only two (B, 3;10 and D, 7;11) had never been observed trying to hide an object. H (aged 4;10), A (aged 8;11) and J (aged 10;2) hide things at home but not at school. Where only the parent or the educator was interviewed, five more children had been observed hiding objects, and in contrast to self-hiding, all except O (7;11) were described as being able to hide things well. The comments generally suggested that the children hid things that they were not supposed to have or touch, and this appears to have occurred more frequently at home than at school, explaining the discrepancy between parents’ and educators’ responses. Mainly, in these situations,

the children were seen to have tried to hide objects in the most available and suitable place on the spur of the moment:

E19

"She doesn't hide things often, but I once found her with my bracelet on without asking, and when she realised that I'd come into the room, she pulled her sleeve down to cover it!" (P of C, 8;2)

Eleven-year-old Se was observed by her classroom assistant hiding sequins during a design and technology lesson:

E20

"Oh yes! She can hide things really well if she wants to ... she loves sequins, and she was making a cushion cover with a repeating pattern of pink and silver, and she asked if there were enough to go round. I said 'probably, but a lot of people are using silver' and when I went back to her, I saw that she'd got a pile of silver sequins hidden under a sheet of paper! When I asked her what she was doing she came straight out with it: 'I've hidden them under here so the other kids can't see them. I need a lot!'"

It is clear from the evidence supplied by these parents and educators, that some blind children are able to hide small objects proficiently when there is sufficient motivation. The poor performance of the blind children reported by Bigelow (1991b) may have more to do with lack of engagement with a task that demands 'make it so I can't see the toy' than with the actual ability to hide objects. So again, the question of appropriate methodology falls into sharp relief.

O (7,11) was again reported by her classroom assistant to hide things as she hides herself:

E21

“... always some part of it visible... O understands the idea of hiding but she can't actually put that idea into practice.”

She went on to describe the struggle to hold many spatial facts simultaneously, whilst also moving self and/or an object through space, and remembering visual rules that have only been taught and never experienced:

E22

“I've tried to explain to her about how we can see bits sticking out, and she can actually talk about what you have to do to hide... but maybe it's just too hard for her to take everything into account when she can't see the whole picture. You know, there's a lot to think about when you're hiding yourself, and even hiding a small thing. She has to remember where you, or whoever, is. She's got to think about the size of what she's hiding and the size of the thing that's going to hide her or an object. Different positions as well – you might not be able to see it from one position, but if you move a touch, you see it... It's a lot for her little mind all at once. Maybe as she gets older, she'll be able to cope with it all, but at the moment, she can't do it.”

This extract echoes what was proposed in Chapter Eleven about the contribution of a number of skills to successful hiding, for example, spatial and visual perspective-taking, and knowledge of object relations.

The notion of age-related improvement is also raised in E18, and while it is probable that, as with most cognitive abilities, the ability to hide self and objects gets better with age, there was some evidence of successful hiding in young blind children. For example, H (4;10) likes to take batteries out of toys, although he gets into trouble for

doing this, and his mother reported that despite his young age, he hides these successfully when at risk of being discovered:

E23

"I said to him 'What are you doing now?' and quick as a flash, he pushes them [the batteries] under his leg so that I can't see them! It might be that that's just a safe place where he can feel them even though they're not in his hands, but I do think he knows that I can't see them there. The problem is though, he doesn't realise that I can see him putting them there!"

Five children had not been observed hiding objects at all and these were B (3;10), G (6;3), M (7;7), D (7;11) and E (11;0). A, (8;11), had only hidden things when prompted by family members. His mother explained that their family play a variation on hide-the-thimble, hiding small objects and using the terms 'You're warm' or 'You're cold' to give clues to the seeker as to how close he/she is to the hidden object:

E24

"We've played that [hide-the-thimble] a lot over the years. We thought it would improve his spatial awareness really, but obviously, it'd help him to understand about hiding as well, like behind or under things or inside things, and he can hide things properly when we play. I can't think of any times though when he's hidden things apart from in the game."

To summarise responses to the last two questions, which both consider blind children's hiding behaviours, only two children had never been observed demonstrating any hiding behaviour at all. These were M (7;7) and E (11;0).

However, two other children, B (3;10) and A (8;11) had only hidden when participating in adult-directed play (see E16 and E24). It seems feasible then to suggest that from the evidence provided by parents and educators of blind children, hiding self and other objects is an activity that most blind children (87% in this study) are able to attempt, with varying levels of success.

Q6: Does C ever ask questions about vision and seeing? If yes, can you give some examples?

Most parents and educators responded positively to this question. Both the mother and teacher of B (3;10) and the teacher of Mo (9;6) said that the child had not asked questions about vision, although Mo had asked his mother about vision.

Many of the responses were closely linked with Q3 (the use of vision related language), Q9 (the impact of naturally occurring events/situations that may facilitate understanding of vision/seeing) and Q11 (conversations that might facilitate understanding of vision/seeing). The examples that the interviewees gave fell into seven categories, and were rich and varied. They are summarised in Table 12.4.

Table 12.4: Nature of examples given by parents and educators to Question 6, by response category

Response category	Parents	Educators
Colour	3	3
Light/dark	2	2
Presence of people or objects	4	3
Aesthetic appearance of other people	1	2
Aesthetic appearance of self	3	4
Aesthetic appearance of own possessions/work	0	2
Visual rules	7	2
Other	5	1

Where children were reported to have asked questions about colour, they were similar to the comments made in response to Q3, which asked about the use of vision related

language, for example simply asking what colour an object was or asking if colours matched or not. Possibly the most interesting instance was offered by the classroom assistant of Se (11;2). She described an incident that occurred during a PSHE lesson relating to skin colour:

E25

“We were talking about skin colour and racism, and we talked about the different skin colours within our class. Se asked questions about different shades of white skin and different shades of black or brown skin. Then she said ‘Well why doesn’t my skin feel different to yours if I’m dark brown and you’re white?’”

Questions about light and dark were again similar to the comments given in response to Q3, and largely focused on why sighted people cannot see in the dark.

Several children had asked questions about whether a person or object was present or could be seen. These were generally practical questions rather than abstract questions about whether or not an object was visible, for example:

E26

“She often asks me if I can see things, like her friend in the playground or the dinner hall, or equipment she needs like her PE kit or swimming bag, but I think that’s just like, ‘cos it’s quicker if I can point things out to her not because she wants to know about vision itself.” (T of D, 7;11).

Many children expressed interest in the aesthetic appearance of other people, themselves (also reported in response to Q3) and objects or work that they produce in

school. C's (8;2) mother described C's interest in the appearance of pop groups and actors in soap operas and other popular programmes:

E27

"C finds it very hard to accept that she can't see and still struggles with that. She's desperate to be able to join in conversations at school and is never content to just sit at the fringe of a group and listen to others, so she asks about what bands and singers look like – you know, McFly, Busted, Robbie [popular musicians in the UK] – 'What colour's his hair', 'What's he wearing?', 'How does he dance?', or she wants to know about what the people on the soaps look like - 'F [friend] said Candice's [character on a popular soap opera] hair is really cool. What does it look like?' ...I kind of tell her as much as I can so that she has as much info as possible to put into conversations with her friends. I just want her to fit in and be able to feel that she belongs in the sighted world."

This theme of belonging in the sighted world was frequently mentioned, and will be discussed further in relation to Q7 (Do you think it's important for children who are blind to develop an understanding about vision and seeing?). As reported above (E12, E13), interviewees were able to offer many examples of children asking about their own appearance, such as whether clothes match, and the appearance of work they had produced in school, for instance asking if a picture looks nice, or if appropriate colours have been selected for paintings or tactile art work.

In addition to themes visited in other questions, this question elicited information about the types of questions blind children ask about visual rules, and also the ways in which they go about testing out their own hypotheses about when vision is or is not

possible. There was no evidence of this in children of six years and under, but nine examples from both home and school in children above that age. Mo (9;6) had recently asked his mother why it was not possible to see round things “... *when you could just reach round and pick it up*”, while A (8;11) was showing interest in what prevents vision, but was also fascinated by transparent barriers:

E28

“He’s always asking about see-through things, and can’t understand how light passes through some materials and not others. He’s particularly intrigued by glasses. He said, ‘If you can’t see through things, why can you see through glasses if they’re in front of your eyes?’ Sunglasses are even more difficult for him – ‘If you can see good in the light why do you need to blank out the light to see better?’” (T of A, 8;11).

Blind children’s quest to find out about vision is apparently affected in many different ways, such as the hiding games described by the teacher of 10-year-old S reported above or as in the account of the parent of Ma (13;5):

E29

“Ma’s interested in whether we can see things, working out when we can’t, and also, he asks about how clearly we can see things. So, for example, he’ll go in the garden and stand in front of the window and he’ll shout, ‘You can see me now mum’, but then he’ll duck down, or go round the corner and shout, ‘But not now ... can you?’ Ma makes statements about whether we can see him rather than ask questions, He already has an idea and just asks for us to confirm it. He doesn’t always get it right, but most of the time now, he does.”

This extract provides another example of how blind children may possess hypotheses about vision, which they test, and presumably update and refine through their interactions with sighted people (see E18).

Six examples were given by the interviewees in response to Q6, which did not fit comfortably into the other categories and these are all worthy of note. These were: anger about being blind; the effects of fog upon vision; how things look in photographs, drawings and on the television, i.e. two-dimensional representations of three-dimensional objects or scenes; and what does seeing feel like? The teacher of S (10;3) gave an amusing account of how S had asked many difficult questions about the effects of fog upon vision, and this dovetailed with Q9 (Are there any naturally occurring events/situations that you think may have helped C to develop an understanding of vision and seeing?), as what had prompted the questions was a comment overheard in the playground that it was ‘so foggy that you can’t see your hand in front of you’:

E30

“He wouldn’t stop going on about it: ‘Why can’t you see your hand in front of you if it’s in front?’ How can the fog block it? Why does the fog block vision?’”

J’s (10;2) mother explained that it is hard to communicate to J how so much information can be condensed onto photograph. Similarly, D’s (7;11) teacher gave an interesting example of how D became confused about the size of objects that she knew from incidental and direct conversation appeared on the pages of books:

E31

She [D] said that she was going to the beach with her bucket and she was going to catch a dolphin. I said, 'You can't fit a dolphin in your bucket D, it's not big enough.' She said, 'It is, they're only little.' I explained to her that they are huge, and we walked along the length of one of the benches in the playground to give her an idea of big they are, and she said, 'They can't be, 'cos there's a picture of one in the book that we read today, and the book's only little!' I had to explain to her about scale and everything, but I still can't understand it, because she knows houses and people are bigger than the page of a book, but she hasn't ever queried that. I think it's maybe just that with things she hasn't experienced herself, it's hard for her to have any idea of what they're like.'

This extract reveals the difficulties that blind children and the adults who teach them experience when trying to understand about the characteristics of things that are not readily available for tactual exploration.

Finally, a question often asked by C (8;2) of her mother and other sighted people:

E32

*"What does seeing **feel** like?"*

As her mother quite aptly asked, "How on earth do you answer that one?"

Q7: Do you think it's important for children who are blind to develop an understanding about vision and seeing? Why/why not?

Without exception, all interviewees believed that it was important for blind children to understand about vision, and the reasons they provided for this belief fell into seven categories, summarised in Table 12.5.

Table 12.5: No. of responses from parents and educators to Q7, by response category

Response category	Parents	Educators
Belonging in the sighted world	10	6
Getting/avoiding attention	2	1
Understanding differences between people	4	2
Spatial understanding	1	3
Social rules, dress/behave appropriately	7	4
Creativity	0	2
Can't explain why	0	2

The theme of belonging in the sighted world was mentioned many times during the course of the interviews and included reference to fitting in both physically and socially, and joining in conversation:

E33

“So that she can join in with others physically and socially, know how to use the right language. She lives in the sighted world and mixes mainly with sighted people. She has to belong – feel at home in that world.” (P of C, 8;2).

Two parents and one educator felt that understanding vision was important for getting and avoiding attention:

E34

“He needs to know that he has to come into the room to show me something, and that I can see him through the glass door or the window when he’s outside.” (P of B, 3;10).

E35

“She needs to know when she can’t be seen, like if she’s on the loo, or just in terms of playing games or being sneaky!” (P of D, 7;11).

Several people talked about how all children need to appreciate diversity between people:

E36

"We all need to appreciate that whether we can see or not, people are different and different people interpret the world differently." (P of Ma, 13;5).

Others applied this specifically to the notion that blind children need to understand the differences between themselves and sighted people:

E37

"No amount of disability awareness will make the world the same for S as it is for his sighted peers and he needs to know that this is the fundamental difference between you and me. (T of S, 10;3).

Three interviewees claimed that they believed that understanding vision facilitated spatial awareness, as proposed by Lewis et al. (2004):

E38

"She loves playing bowls, and we count the paces, and she knows that me and the other kids can see, but that doesn't stop her joining in. I think that understanding, or trying to understand that sighted people see the whole picture as it were, gives her an insight into the overall appearance of a space, and not just in terms of a route." (CA of O, 7;11).

References to knowledge of social rules including dressing and behaving appropriately were common, and the comment of Mo's (9;6) teacher encapsulated many of these ideas:

E39

“Knowing how he looks to others, how his appearance can be attractive or not, like he needs to wipe his runny nose, or how food and drink around his mouth look horrible to sighted people, or eating with his mouth open. Wearing clothes that match and look clean and tidy too. And smiling at people when he’s talking to them ...”

Two educators made comments about art and creativity:

E40

... I don’t want to let her use random colours, ‘cos when she goes to uni, I don’t want someone saying, ‘Well O, actually no, people don’t have green faces and cows aren’t pink.’ (CA of O, 7;11).

E41

“When she’s doing artwork, whether it’s pictures or tactile pictures or collage or clay work, it’s important that she uses colour appropriately. I don’t agree with people who say that because she can’t see it, it doesn’t matter. It does matter.” (T of J, 10;2).

Such comments reflect the views of Carey (2002), who argues that it is relevant and appropriate to teach blind children about visual concepts, including colour.

In summary, the general consensus was that it is important for blind children to understand about vision, and while two educators were unable to explain why they held this view, the remaining interviewees cited mainly social reasons to support their views. Parents particularly stressed the importance of ‘belonging in the sighted world’ and following social rules, and whilst this was echoed by educators, three also cited the importance of vision for spatial development and understanding and two, its

contribution to creativity. Only one parent mentioned spatial development in this context, and none referred to creative development.

Q8: Have you ever played games or conducted activities specifically to help C understand about vision and seeing?

Q8 to Q11 began to explore what Carey (2002) might be referring to when he suggests that sighted people should use ‘special means’ in order to support blind children in their acquisition and use of visual language. The questions attempted to draw out information about explicit activities and conversations parents and educators use in order to develop and extend congenitally blind children’s knowledge about vision.

Where both a parent and an educator were interviewed about one child, in three cases, both said they had not played games or conducted activities specifically to help the child to understand about vision (B,3;10; H, 4;10, and Mo, 9;6), while in one case (J, 10;2) both the parent and the educator had. D (7;11) and A (8;11) had played games and conducted activities of this nature at home but not at school, while the opposite was true for Se (11;2). While the parent and educator of B (3;10) said that they had not organised activities specifically for this purpose, both said that they played hide-and-seek and peek-a-boo with him, and believed that this would help his understanding of vision. The parents of C (8;2), Be (11;8) and Ma (13;5) had both played games and conducted activities to help the child understand vision. The parents of G (6;3) and M (7;7) were not interviewed, and in the cases of both children, neither of the educators interviewed had organised games or activities to help the child understand visual concepts. Thus, ten children were known to have played

games and activities to facilitate understanding of vision either at home, at school or both.

The examples given were organised into four categories, displayed in Table 12.6.

Table 12.6: No. of responses from parents and educators to Q8, by response category

Response category	Parents	Educators
Hiding games	6	3
Art and technology	0	2
Bowling	0	1
Swimming and other PE activities	0	2

The responses of parents were limited to the playing of hiding games, but these were rich and diverse, and included hide-and-seek with parents, siblings and peers. Two parents organised Easter-egg-hunts each year. On a similar theme, one parent had played hide-the-thimble-type games with her child (see E24). The following two extracts illustrate how two families organised unstructured and structured activities in order to increase their children’s understanding of vision:

E42

“The kids have always loved to play hide-and-seek and we realised early on that J would benefit from this... Me or her dad would help her when she was younger, or T [older brother] you know, we’d pair with her, and then she’d maybe sometimes pair up with M [twin] but now, well she’s on her own and she survives. She’s really good at it and of course here at home, we’ve got a big house and a massive garden and she knows all the places to go.” (P of J, 10;2).

E43

“We do an Easter-egg-hunt in the garden every year [Ma has two younger siblings] and Ma understands that he has to search in enclosed spaces, behind a fern for example. He still loves it, he pretends that he’s too

grown up now and only does it to humour the others, but he's very competitive. We don't cut him any slack – he has to play fair and square.”

(P of Ma, 13;5).

Many of the parents and educators interviewed echoed this sentiment of not making allowances in games and activities, and these were often linked with the common thread that can be traced throughout, of living and surviving in the sighted world.

A number of references have been made above to how educators use art and design and technology activities in order to promote understanding of visual concepts (e.g. E40 and E41), so no further discussion of this will take place here.

Reference to physical activities generally focused on PE or swimming lessons, and where these were mentioned, educators had used activities to extend the children's knowledge and understanding in a number of ways. See E38 for an example of how a game of bowls was used to develop the idea of the range of the visual field. This same classroom assistant also used swimming lessons to develop O's (7;11) understanding:

E44

“When we go swimming, I go in the pool with her and I tell her what I can see. I tell her that water in my eyes makes my vision blurred, and although I can see under water, everything is distorted and looks wobbly.”

Teaching ball skills was also seen as an opportunity to extend understanding about vision:

E45

“...in ball skills, he uses his hearing to detect where the ball bounces, but he needs to understand that sighted people need to see how the ball approaches them, so he knows that they need to be facing towards him

before he kicks or throws the ball, even if we're using a sound ball." (T of Mo, 9;6).

These extracts suggest that many children who are blind (60% of this sample) are given the opportunity to access games and activities that may help them to understand about vision. The extracts also begin to reveal what ‘special means’ sighted parents and educators might use specifically to develop blind children’s knowledge about vision and seeing.

Q9: Are there any naturally occurring events/situations that you think may have helped C to develop an understanding of vision and seeing?

Many spontaneous events that parents and educators have used to develop understanding of vision have been reported above, for example E2, where Mo’s (9;6) teacher recounted how the falling autumn leaves provided an opportunity to talk about vision, or E25, in which Se (11;2) asked why brown skin does not feel different from white skin. In addition to those reported above, interviewees identified many naturally occurring event, summarised in Table 12.7.

Table 12.7: No. of responses from parents and educators to Q9, by response category

Response category	Parents' responses	Educators' responses
Game playing	3	1
Showing things to sighted people	1	2
Trips and outings	3	2
Incidental conversation	6	7
Household events	4	5
Unusual events	4	0
Common events	5	1
Physical interactions with sighted people	3	2

Game playing examples usually referred to hiding games, many examples of which have been presented above, but additionally, there was reference to playing ball games or table-top games such as snakes-and-ladders:

E46

"We play snakes-and-ladders with an adapted tactile board. E knows that we can see the whole thing so we know where everyone is on the board just by a glance, whereas he has to feel his way around much more." (P of E, 11;0).

This extract is closely linked with Q8, yet E's mother replied in response to that question that she had never played games specifically to help E understand about vision. It seems then that she played games primarily for fun, but on reflection, realised that such activities did indeed contribute to developing her child's understanding.

Three people said that when blind children want to show an object to a sighted person, they learn when sighted people can or cannot see what is to be shown:

E47

"Well, he knows he has to be in the same room as me if he wants to show me something, but he knows as well that I don't have to touch it, he can say, 'Look Mummy' and I can see even if I'm here and he's over there."
(P. of B, 3;10).

Trips and outing were given as examples by three parents and two educators. Ma's (13;5) father gave the example of walking by a stream and trying to explain what running water looked like, while D's (7;11) mother talked about a trip to the seaside:

E48

"Just talking to her about the wide open space of the sea, and the colours – the sand, and the sea and the sky, and being able to see boats out at sea."

The fun-fair as well, seeing things going up, like the big dipper or the big wheel, and talking about things looking blurred when they're moving fast."

Household events were seen as a source of information about vision, for instance unpacking shopping, filling the kettle, turning lights on and off, preparing food were all given as examples, and parents particularly suggested that helping with such activities, and providing children with a running commentary, would without doubt extend their language and understanding of vision:

E49

"Preparing food, making a salad, telling him about green, red, yellow peppers, about onions – red, white, Spanish, spring, shallots – all the same family but all look different. Making cakes, beating butter and sugar together and the colour gets paler and paler, beating eggs and watching the yolk and white mix together into a mass, or whisking egg white and watching it change from transparent to an opaque white. These are things that she often can't know through touch, or often through taste even, so it's up to us to describe it all for her, so that she will know how these things look." (P of D, 7;11).

Unusual events were also seen as a good source of information and learning:

E50

"We had major building work done when Ma was younger, and we used to let him explore the house as the changes were being made, so he walked through new spaces where walls were knocked down and climbed up ladders to the loft space where ceilings had been pulled down. He began

to understand then about how walls and ceilings and so on weren't only stopping us from getting through but also from seeing through, so he knew he could be seen from one room to another, where he couldn't before the wall came down, or after it was rebuilt." (P of Ma, 13;5).

Finally in this section, an example in which a child believed that heat could be seen, which also relates to Q12 (Do you think C's experience of the other senses helps him/her to understand about vision and seeing?):

E51

"I burnt my hand on a hot plate, and Ma couldn't understand why I couldn't see the heat. He thought that a hot plate would look different to a cold one! (P of Ma,13;5).

Common or everyday events were suggested as learning opportunities by five parents and one educator. One such example picked up a thread that had been identified in response to Q6 and illustrated by E31 - how things look in photographs, drawings or on the television, that is, two-dimensional representations of three-dimensional objects or scenes:

E52

"... looking at holiday photographs with her, she finds it hard to understand how things can be made to look so small on a little piece of paper, or even on telly. It's hard to explain because there isn't really a proper equivalent to the other senses ... you know, you can talk about whispers being a small equivalent of a shout, or a doll's house being a small equivalent of a real house, or a toy cow, you know, but it's not the

same, because they're still kind of full, aren't they, while a photo's flat and so's the telly." (P of C, 8;2).

Ma's (13;5) mother gave the example of dropping or not being able to find things:

E53

"Ma knows from experience that if he drops something, or if he can't find something, we can usually get it instantly."

Further understanding about transparency came to J (10;2) through being told that her dark underwear was visible through a white dress:

E54

"... she was surprised to find that out, and she asked questions for weeks then about what fabrics could be seen through and how we could see through one but not another."

Responses in the final category – physical interactions with sighted people – often referred to blind children coming to an understanding of sighted people moving quickly through space:

E55

"He's learnt though trial and error that sighted people can move, do things much quicker than him, and to be honest, we're concerned, because he's given up trying to keep up with the lads. He's much happier with the girls, 'cos they like to sit round and talk, and he can join in... but we'd like to see him doing a bit more physical play." (T of Mo, 9;6).

This extract, as well as illustrating how physical interactions with sighted people gives blind children information about vision, also highlights the problems sometimes

experienced by blind children when attempting to engage with sighted peers, and gives an example of how one child has learnt to deal with the problem.

In summary, both parents and educators were able to identify many naturally occurring events that they believed would help blind children to understand more about vision and seeing. Social and physical interactions with sighted people, such as conversation and game playing were cited by many interviewees as instrumental in developing blind children's knowledge about seeing. Also, frequently occurring everyday events such as shopping, and more unusual events, for example major building work to the child's home, were reported as facilitating understanding of vision.

Q10. Do you think that interactions with sighted peers and siblings affects C's understanding about vision and seeing? If yes, in what ways?

Many of the examples given above were referred back to by interviewees when posed with this question (see E39, E42, E45, E55 for example). All the educators and ten of the 11 parents interviewed said that they thought interactions with sighted peers and siblings improved blind children's understanding of vision, but one parent replied that she wasn't sure. All of these, except one parent, cited exposure to visual language as a beneficial effect, and educators tended to be much more specific than parents when they referred to this. Parents made general reference, for example:

E56

"He hears sighted kids talking about what they can see and describing how things look." (P of B, 3;10).

Educators tended to give specific examples:

E57

“Well she learns the social skills of sight when she hears kids say things – ‘That looks gross’... She learns about what clothes look good and what’s attractive, like she’s always saying that her favourite colour’s pink.” (CA. of O, 7;11).

E58

“G realises that we often have to adapt the curriculum for her, like in art, or PE or science, she might have to do slightly different activities than her friends who can see, and obviously, whenever she’s using Braille, she knows that’s unique to her.” (T of G, 6;3)

Physical interactions and games were also mentioned by approximately 50 per cent of parents and educators especially with reference to blind children not being able to keep up physically with their sighted peers:

E59

“He’s good friends with a lot of girls who – and I’m not being sexist here – are generally a lot more interested in chat than in rough-and-tumble by this age. He knows he can’t keep up with chasing or football in the playground, and apart from that, a lot of girls like explaining things in detail to him, where the boys often can’t be bothered.” (T of S, 10;3).

This last extract echoes what the teacher of Mo (E55) noted: both boys are tending toward more friendships with girls than their educators would expect at this age, and they are inclined to think that this is because girls’ interactions have more of a conversational focus than do the interactions of boys, who more often play physical games.

Two parents and two educators claimed that interactions with sighted children developed understanding of the differences between blind and sighted people:

E60

“Mixing with his sister and sighted kids his own age helps him to understand that they can do things and experience things different to him, so he will come to know that he’s different, but I hope that won’t be a negative thing for H. “ (CA of H, 4;10).

In summary, all but one interviewee believed that interactions with sighted peers and siblings helped blind children to understand about vision, and this was largely attributed to the effects of verbal interactions. Physical contact was mentioned by approximately half of the interviewees in both the parent and the educator groups. In addition to general understanding about vision, 17 per cent of parents and 18 per cent of educators said that interactions with sighted peers and siblings particularly helped blind children to understand the differences between blind and sighted people.

Q11. Have you ever talked with C about things that you think might have helped him/her to understand about vision and seeing?

All the interviewees said that they had talked about things that might have helped the child to understand about vision and seeing. As the interviews developed, overlap between the responses increased and interviewees frequently referred to comments and examples they had given earlier. There were general comments, for example:

E61

“Yes, since she was little. We’ve always given her a running commentary about how things look.” (P of C, 8;2).

More specifically, twelve themes were identified, summarised in Table 12.8.

Table 12.8: No. of responses from parents and educators to Q11, by response category

Response category	Parents	Educators
Colour	7	9
General description of visual features	4	5
Saying what can be seen	2	0
Reflection	4	2
Dark, light and shadow	3	5
Size	3	5
Barriers	2	4
Social behaviour	3	2
Movement	2	0
Magnification	1	3
Transparency	2	4
Distance	2	1

The majority (73%) of interviewees reported that they had talked to the child about colour and many examples are given above (e.g. E9, E10, E13 E20, E25, E40 and E49). Similarly, several people referred to the ‘running commentaries’ they provided:

E62

“We’ve always used all opportunities to describe things ... fairy lights, Christmas trees, fireworks, and like I said before, saying, ‘We’re going past a big green field now with black and white cows, and they’re munching grass, and there’s yellow buttercups, they’re waving about in the breeze.’” (P of D, 7;11).

Two parents said that they often preface descriptions with, “We can see that ...” in order to make it clear to their child that the information is being gained through the visual modality.

Reflection had been discussed by parents usually in response to looking in the mirror, but by educators as part of the science curriculum. Similarly, dark and light were

discussed at home usually in reference to putting on the light on arrival home, or the car lights when driving at night, but at school, it had been discussed in more scientific terms.

A's (aged 8;11) mother gave an account of how she had explained to A about how an object's size affects its visibility:

E63

"I dropped the back of my earring on the floor, and I couldn't find it. He was saying, 'Just look for it Mum, why can't you see it?' I explained that little things are harder to see than big things, like little sounds are harder to hear than big sounds. We got on to talking about tiny things that are invisible to the naked eye, and magnifying glasses and telescopes and what have you."

Where barriers were discussed, usually it had been in response to a child asking why an object or person couldn't be seen:

E64

"She asks, 'Can you see where my mum's parked her car?' and at certain points, I have to say, 'No the wall or the hedge is in the way', or 'I won't be able to see 'til we've gone round the corner.'" (CA of O, 7;11).

Many references have been made to social behaviour above (e.g. E39 and E57) so no further examples of this will be reported.

The effects on vision of movement had been explained by two parents. The father of one child is a professional cricketer, and therefore, many discussions took place about

bowling speeds and the need for the batsman to keep his eye on the ball. The child's mother said that she felt that talking about this, both specifically and generally had increased her child's understanding of this phenomenon. Another child's mother plays golf, and she reported the following:

E65

"I try to explain to her that when I first hit the ball, it's going so fast that we can't follow its movement with our eyes. Then, as it begins to drop, we can usually pick it up, and by the time it hits the ground and it's rolling, it's easy to see and track. I don't know how much of that she grasps, but at least it must give her some idea." (P of C, 8;2).

Magnification was talked about by educators, again, usually in the context of the science curriculum:

E66

"We've discussed magnifying glasses when the other children have been using them in science lessons." (T of Mo, 9;6).

A number of references have been made above to transparency (see E2 and E28) and educators usually referred once again to the science curriculum when giving examples of talking about transparent and opaque materials to the children.

The three people who cited distance as one of the things they had discussed all said that they believed the child had found this hard to comprehend:

E67

"We were going to France on the ferry and it was a lovely clear day and we could see France as we drove down to the port. Be wouldn't believe us

and he just wouldn't have it – he thought we were teasing him and he got really cross.” (P of Be, 11;8).

Both parents and educators then, had talked to the blind children about many things that may facilitate understanding of vision, but as the parents of eight-year-old C (E65) and 11-year-old Be (E67) pointed out, a crucial issue is how much the children have understood.

The extracts reported from Q8 to Q11 provide a comprehensive account of how the parents and educators of blind children can provide a rich environment in which blind children learn about vision, and possibly pinpoint some of the ‘special means’ suggested by Carey (1992).

Q12. Do you think C's experience of the other senses (touch, hearing, smell and taste) helps him/her to understand about vision and seeing? If yes, how?

Most of the interviewees found this question difficult to answer. Three parents and four educators said yes, while one parent and four educators said no. The rest said that they did not know whether the child's experience of the other senses facilitated understanding about vision and seeing. For the parents who said they thought experience of the other sensory modalities facilitated understanding of vision, the emphasis was on the tactual modality:

E68

“Yes I do. She gets information about an object's texture and size and depth and so on. Although that's not visual to her, she gets some idea that

when things are different tactually, they're usually different visually" (P of D, 7;11).

Educators gave similar responses but also made reference to sensory modalities other than touch:

E69

"Yes, she learns through touching and smelling, or touching and tasting, that things can be experienced in different ways. So she knows an orange is round, small and usually quite rough to the touch. But she also knows that those things don't define an orange – it has a unique taste of its own, and she may only be able to identify it through taste, or smell, and not simply by touch." (CA of O, 7;11).

When interviewees stated that they did not think that the other modalities helped blind children to understand vision, confusion was generally the reason cited:

E70

"It can be confusing for him, y'know, it's hard for him to understand that he can be seen even if he's too far away to be touched, or even heard." (T. of S, 10;3).

The majority of parents (64%) said that they didn't know, weren't sure or had never thought about it, and while the number of educators who said this was less, there was a sizable number (27%) who had not given this idea any thought.

The mixed views of parents and educators about the effect of the experience of the other four sensory modalities upon understanding of vision reflects the comments and

performance of the blind children in the studies reported in this thesis. In some situations where the same rule applies for seeing as for one of the other modalities, experience of the other modality may facilitate understanding of vision and seeing. For example, both seeing and hearing are possible when at a one-metre distance from the target object or sound, when there is no occluding barrier in place and the viewer or listener is facing towards the target. So, if a blind child used his or her experience of hearing to predict whether seeing was possible within those same parameters, then the prediction would be correct. However, if one of those parameters were altered, for example by the placement of an occluding barrier, then application of the auditory rule – sound can travel around corners – would result in an incorrect prediction about whether or not vision was possible. Many of the blind children's errors in the study that investigated blind and sighted children's understanding of the visual and auditory experience of another person (Study 2) were possibly a result of the application of rules from other sensory modalities when trying to predict whether vision was possible or not.

To summarise responses to Q12, opinions were mixed. Thirty per cent of interviewees believed that experience of the four other sensory modalities was helpful for blind children's understanding of vision and seeing, while 17 per cent said that they thought it was not helpful and actually caused confusion. The remaining 52 per cent of interviewees were unable to answer the question.

Q13. i) Is there anything in the National Curriculum that you think would help a blind child to develop an understanding about vision and seeing? ii) Are there any ways in which this could be improved or developed?

This question was directed at educators only, and a number of earlier questions elicited information about the National Curriculum. For example, references to art (E40), PE (E45), and to science (E65). These subjects were again cited frequently in response to Question 13. Part 1 of the question will be discussed first. The themes mentioned were organised into five categories (Table 12.9).

Table 12.9: No. of responses from educators to Q13, by response category

Response category	Educators
Science	8
PE	5
Art	6
Design and technology	5
Trips and outings	1

In terms of the science curriculum, the same areas cited above were repeated: light and dark; opacity and transparency; the eye and vision, etc. Additionally, one educator said that through the Foundation Curriculum area Knowledge and Understanding of the World, blind children learn visual adjectives such as ‘brown’, ‘shiny’ and ‘shimmering’ etc.

Art and design and technology were discussed in terms of colour, as described many times above, and similarly, the examples relating to PE were repeated in response to Q13. Off-site trips and outings, which were mentioned briefly in response to Q9, and are not linked to any particular curricular area, were mentioned again here by the CA of O (7;11):

E71

“I think off-site activities are good, provided they’re appropriate for O because she can engage with them, like if we visit a farm, she can touch animals, feel them, hear them.”

In response to the second part of the question which related to improving the curriculum, many educators felt that there should be a lot more opportunities for practical work, and many believed that the current practice of Literacy and Numeracy hour-type approaches, which involve children sitting and listening to adult exposition of concepts and ideas, are inappropriate for children who are blind. There was a call for more use of artefacts, multi-sensory teaching, extra-curricular activities, tactile work in art and in maths, and as one teacher stated succinctly:

E72

“The VI curriculum is overloaded, and the ordinary curriculum is often, frankly, inappropriate for blind kids. Whatever happened to child-led learning? And as for Every Child Matters [(DfES, 2003)] – don’t make me laugh!” (T of S, 10;3).

It was apparent that although educators recognised that there are some components within the National Curriculum that are useful for blind children in terms of teaching them visual language and concepts, they felt that many improvements could be made to the content in order to make the curriculum more relevant, and also to the ways in which teaching is delivered. Without exception, they said that making the work relevant and accessible to blind children is the responsibility of the individual practitioner, and the pressures of the VI curriculum, on top of the general curriculum (which many feel is already overloaded) make this a very challenging task, for both the educator and the child.

There were two notable additional concerns raised in response to the question about the National Curriculum. First, three educators expressed concern about the placement of blind children within lower-ability teaching groups in some schools:

E73

"I get frustrated because she's always lumped together with the SEN kids. She doesn't have learning difficulties, in fact, she's one of the brightest kids I've ever known. I wish people could see beyond her blindness. One teacher asked me why I was typing stuff up for D in French – D goes to French club. I said, 'Well, she's learning French' and she said, 'She'll never be able to use it, she's not going to be able to go to France is she?' I was furious. I said, 'She's blind you know, not immobile, and she certainly doesn't have a communication problem!'" (CA of D, 7;11).

Second, two educators gave accounts of how some distress had been caused to the blind children with whom they work through the content of RE lessons:

E74

"We watched a video about a blind boy who went to Lourdes [a place of pilgrimage, where healing miracles are reported to have taken place] and he was healed and was able to see. When it was finished we asked if anyone had any questions and A put his hand up and said 'When can I go?' I didn't know whether to laugh or cry. It was really difficult. The main problem I suppose was that whoever had planned that lesson hadn't thought about how it might affect A." (T of A, 8;11).

The other comment connected to this issue was in a similar vein and related to the healing miracles reported in the Christian gospels, where there are a number of accounts of Jesus restoring sight to blind people:

E75

"I'm not saying that we shouldn't teach them about this, just that we need to think carefully about their age and their ability to deal with it. And also, to think about how we're going to deal with any distress or confusion it might cause." (T. of D, 7;11).

The final item in the interview invited further comments, and two parents brought up the issue of children's anger and frustration at being blind (which had first been raised by C's mother, reported in E27):

E76

"A gets very angry about not being able to see, and he won't accept that he will never be able to see. He still insists at times, that his eyes will soon get better, and he will be able to see." (P of A, 8;11).

This comment referred to the child who was distressed by the film about Lourdes, and as such, adds weight to the comment in E75 that educators need to think carefully about how a blind child might be affected by such accounts.

12.4. General discussion

The interviews yielded rich data about the views of parents and educators about congenitally blind children's understanding of vision. It drew upon their experiences of blind children's use of visual terms and understanding of visual concepts. It also explored the ways in which blind children learn about vision, both through incidental, naturally occurring events and through specific activities and explanations that are

deliberately directed to extending their knowledge and understanding of visual concepts.

The findings supported those of previous studies that blind children use visual terms fluently and appropriately, that they use 'see' and 'look' to refer to their own ways of perceiving sensory information and that they understand that sighted people 'see' things differently from the way they do themselves (e.g. Brambring, 2005; Brown & Bellugi, 1964; Landau & Gleitman, 1985; Nock et al., 2003a; Nock et al., 2003b).

Parents and educators were invited to give examples of how blind children demonstrate their understanding of vision through their language and behaviour. Only the two youngest children (aged 3;10 and 4;10) were believed to have no understanding of vision, thinking of it as the same as touch or hearing. All the children were reported to use visual terms frequently and spontaneously. 'Look', 'see' and 'watch' were used to refer to the children's own way of perceiving sensory information and also to refer to actual visual perception in sighted people. Colour terms were used by all the children, although the older children used them more proficiently, to ask about their own or others' appearance, or work products, such as paintings that they had produced in school, while the youngest tended to use colour terms as descriptors that they heard other use, such as 'the blue car'.

The interviewees were asked about the children's hiding behaviours, in the hope that this would also provide some insight into what the children understood about occlusion and exposure. All the children except M (7;7) had some experience of the concept of 'hidden-ness', either through hiding themselves or objects. In some cases,

this had occurred spontaneously, but in others, the children had been directed, either at school or at home to hiding games such as hide-and-seek, Easter-egg-hunts, or variations on the theme of hide-the-thimble. The accounts of those interviewed corresponded in some cases with the children's' performance in the Hide-and-Seek task, reported in the previous chapter. The child who had not hidden at all in that task (aged 7;7) had never been seen hiding at home or school, nor had she ever been introduced to hiding games. The two children who only hid partially (aged 7;11 and 8;2) were also reported by the interviewees to attempt to hide themselves, but not always with success. However, two children who had not been observed hiding at school or at home (aged 4;10 and 8;11) hid successfully in the Hide-and-Seek task, but both had been observed hiding objects successfully, and it is possible that they understood something of the nature of 'hidden-ness' through this experience.

All the interviewees expressed the opinion that it is important for blind children to understand about vision, although two were unable to explain why they believed this. Social reasons were offered to support this opinion, with parents particularly emphasising the importance of 'belonging in the sighted world'. Educators focused more upon the importance of understanding about vision as a contributory factor to spatial development and creativity.

Several interview questions focused on the use of explicit conversation and activities to develop blind children's understanding about vision. These aimed to discover what 'special means' mentioned by Carey (2002) are used by parents and educators to facilitate the development of blind children's understanding of vision. Half of the parents and three of the eleven educators had played hiding games with the children.

Educators had also carried out activities in art, technology and PE lessons specifically to help the children grasp visual concepts. The majority of those interviewed had talked to the children about visual concepts, and a wide range of examples was given. Many had discussed colour and given descriptions of visual features. Parents and educators alike had discussed complex concepts, such as reflection, transparency and magnification, and a number of the factors that had been used in the Ranking task (Study 3). For example the effects on vision of size of object, barriers, light and distance were topics that had been considered in conversation with the children.

Attention then turned away from activities and conversation that had been specifically intended to improve blind children's knowledge about visual concepts to those events that occur naturally. Responses indicated that such events were common and were used by parents and educators to further the children's understanding of vision. Many cited incidental conversation and everyday events, such as shopping and preparing meals as a source of knowledge. Trips and outings, for example to the seaside, and unusual events, such as major building work in the home, had also provided opportunities for conversation about visual concepts. Game-playing, particularly hiding games, were cited by both educators and parents, as were ball games and table-top games such as snakes-and-ladders.

All but one interviewee stated that they considered interactions with sighted peers and siblings to be useful in terms of developing blind children's understanding of vision, particularly because of the exposure to visual language.

When the interviewees were asked about how the experience of touch, hearing, smell and taste might help blind children to understand about vision, over half of them were unable to answer the question. Approximately a third of interviewees stated that the other senses, particularly the tactual modality, facilitate understanding of vision. One parent and four educators said that they believed that the children confused the rules of perception in other modalities with those of the visual modality, thus impeding rather than improving understanding. This could be linked to blind children's possible use of analogies to other modalities in both the Understanding Vision task (Study 2) and the True or False task (Study 4).

The final theme focused on the education system in England and Wales, and asked whether it promotes blind children's understanding about vision. Only educators were asked this question and they cited science, PE, art, design and technology and off-site outings as opportunities for teaching blind children about visual concepts. However, there were criticisms of the curriculum, particularly that it was overloaded for blind children, largely because of the demands of fitting in the curriculum for the blind alongside the National Curriculum. Concerns were also raised about references to restoring sight to blind people in the RE curriculum, and the effects of such stories on children who are blind, and the common practice of placing children who are blind in what was termed as 'SEN groups' or 'lower-ability groups' within mainstream classrooms, based on the assumption that such children have learning difficulties. In the case of all the children in this study, this was not the case. These issues will be picked up in the final chapter.

An additional point of interest was that many educators and parents commented that taking part in the interview had raised their own awareness of the importance of teaching blind children about vision, and their determination to do so in the future. This too will be picked up in the final chapter.

CHAPTER THIRTEEN

DISCUSSION

13.1 Introduction

The purpose of this thesis was to explore how congenital blindness affects the development of understanding of vision, and five aims provided a framework for this exploration: (i) to explore whether, and if so to what extent, the absence of visual experience influences the development of understanding of the aspectuality of knowledge; (ii) to examine whether, and if so to what extent, the absence of visual experience influences the ability to take the visual and auditory perspectives of another person; (iii) to investigate and compare the opinions of blind and sighted children about the phenomena that affect vision; (iv) to explore blind children's ability to hide themselves, as an indication of their ability to take the visual perspective of another person; and (v) to consider some social influences upon the development of understanding of vision and the language of vision.

Six empirical studies addressed these aims by investigating how blind children demonstrated their understanding of vision, both through performance on tasks and through seeking their opinions. Where appropriate, their performance on tasks and their explanations and comments were compared to those of sighted children. The views of parents and educators of congenitally blind children were sought in order to further knowledge and understanding about some of the social influences that facilitate congenitally blind children's understanding of vision. A summary of findings from the empirical studies is presented in the next section, followed by a discussion of their implications and some suggestions for future research. A critique

of the work in this thesis is then presented, and finally, the contribution that the thesis has made to furthering understanding about how congenital blindness affects the development of understanding of vision is considered.

13.2. Summary of findings

The first of the empirical studies, which considered the understanding of vision within the theoretical framework of understanding of the aspectuality of knowledge, was reported in **Chapter Seven**. Eight congenitally blind children aged between 3;6 to 9;5 and 30 sighted children aged between 3;6 and 6;5. participated in the study. Three main areas were investigated: first, age-related improvements in understanding the relationship between sensory experience and knowledge in both blind and sighted children; second, the possibility that blind children may over-estimate the role of touch in the acquisition of knowledge in a similar way to that which sighted children over-estimate the role of vision (O'Neill et al., 1992; Woolley & Bruell, 1996); and third, the relationship between theory of mind and understanding about aspectuality in blind and sighted children.

Both blind and sighted children demonstrated age-related improvements in performance on tasks that investigated their understanding of the aspectuality of knowledge, with sighted children showing proficiency across the five modalities under investigation (vision, audition, touch, taste and olfaction) at around 5½ to 6½ years of age and blind children reaching proficiency at around 7½ years.

Although the intention had been to carry out statistical analysis on the errors that the blind children had made in the understanding of aspectuality tasks in order to

investigate whether they showed a bias toward the tactual modality, in the event, this was not possible because the blind children made so few errors. However, trends in the data (11 out of 13 recorded errors) led to the tentative suggestion that they did indeed over-estimate the role of touch in the acquisition of knowledge, and this was particularly evident in tasks where the taste modality was under investigation. In line with Robinson et al. (1997), sighted children over-estimated the role of touch and also vision (O'Neill et al., 1992).

In the case of the sighted children, there was a positive relationship between performance on theory of mind tasks and performance on the understanding of aspectuality tasks, but not in the case of the blind children, and the two youngest blind children, who scored zero and one out of a possible six points on the theory of mind tasks, both achieved some success with the aspectuality measures, particularly in the tactile and auditory modalities. This provides some evidence of their awareness of the association between hearing/touch and knowledge that may be equivalent to sighted children's awareness of the association between seeing and knowledge, which precedes the understanding that there is a causal relationship between sensory experiences and knowledge (O'Neill & Gopnik, 1991; Perner, 1991). The first study also found evidence of blind children's understanding of mind at an earlier age than has been reported previously.

The study reported in **Chapter Eight** narrowed the focus down to two modalities: vision and audition. The former because vision is the modality upon which the thesis is centred, and the latter because good understanding of that modality was demonstrated by both blind and sighted children in Study 1, and also because there is

some equivalence between the auditory experiences of blind and sighted children. The same eight congenitally blind children and 30 sighted children who had participated in Study 1 took part in Study 2, which explored the ability of blind and sighted children to take the auditory and visual perspectives of another person. There were two main areas under investigation: auditory and visual perspective-taking when the parameters of barriers, distance and the orientation of the both listener/viewer and the person who is their auditory or visual target are manipulated; and the use of cross-modality analogies by blind children. The study also aimed to ask children to explain their predictions in order to gain some insight into how their decisions were reached.

The results indicated that sighted children were, unsurprisingly, better than their blind peers at visual perspective-taking, and sighted children were also better at visual perspective-taking than at auditory perspective-taking. Blind children performed at similar levels over both tasks, and also performed at a similar level to sighted children on the auditory perspective-taking task. The effects of distance were most problematic for the blind children to deal with, and generally, they tended to predict that distances of 15- to 20-metres prevented vision, and they frequently equated proximity with vision, regardless of the presence of occluding barriers or of the viewer being oriented away from the visual target.

There was some evidence to suggest that blind children used analogies to the auditory modality when making predictions about visibility, and several examples of this were given. Younger sighted children also made similar cross-modality references, although this was observed less frequently in sighted than in blind children. It was concluded that it would be inaccurate to suggest that only blind children use this type

of reasoning and that sighted children also may apply rules about one modality to another.

Although the blind children were less proficient than the sighted children in the visual perspective-taking task, Chapter Eight drew attention to the fact the blind children in the study demonstrated that they had a very good understanding of vision, and their responses when asked to explain why they believed that the viewer could or could not see the visual target demonstrated that they understood something of the effects of distance, occlusion and orientation.

In the study reported in **Chapter Nine**, attention was focused upon understanding vision alone, investigating children's own opinions about what factors affect vision, in contrast to earlier work, which has drawn upon adult understanding. Through a process of survey and questionnaire, nine factors that sighted children believe to be important for vision were generated: eyes open; light; distance; noise; corners; smells; barriers; size of object; and health of eyes. A task that required the children to rank the factors in order of importance for vision was administered to 50 sighted children aged between 8;0 and 12;11 and 12 congenitally blind children with no other physical or cognitive impairments aged between 7;11 and 14;8. The results revealed that blind and sighted children hold very similar opinions about the importance of the nine factors that were considered, and both groups ranked open eyes and health of eyes as the most important for vision, and smells and noise as the least important. This finding was surprising given the discrepancy in the performance of blind and sighted children on visual perspective-taking tasks. It was concluded that blind children know which factors are important for vision, but do not understand the finer details about

exactly *how* vision is affected by such factors. It was suggested that as blind children's knowledge about vision is based upon explanations about how vision works, or upon information gained incidentally, rather than being first-hand and experiential, it may be difficult to assimilate this knowledge with accuracy. So although they may be able to state, for example, that open eyes are fundamental to the ability to be able to see, a comprehensive understanding of the complexities and degrees of vision that is often necessary for visual perspective-taking tasks, is more difficult for them to achieve.

Information about blind children's sources of knowledge about vision, were elicited, and the two that were frequently mentioned were information that they had been told directly or overheard in incidental conversation, and scientific knowledge gained in the classroom.

The study reported in **Chapter Ten** continued to explore what blind and sighted children understand about vision, not only in terms of whether vision is possible or not, but also considering clarity of vision. A 'True or False' type task was developed, which was composed of 16 statements that drew upon common areas of misunderstanding that had been identified from comments made by blind children in the previous studies, and also reported in earlier research (e.g. Bigelow, 1988, 1991a, 1991b, 1992; Nock et al., 2003a; Nock et al., 2003b; Nock et al., 2004). The task was administered to 12 congenitally blind children aged between 7;11 and 14;8 and 12 sighted children, matched for age and sex. It was predicted that the sighted children would demonstrate more accuracy in the task than would the blind children and the

results supported the prediction. The blind children did, however, score at levels above those that would be predicted by chance.

When the statements were considered individually, the scores were significantly different for only three of them. The blind children demonstrated better understanding of the straight-line rule than did their sighted peers. The sighted children were more accurate than the blind children on two statements: one that related to the effect upon vision of angle and one that explored understanding of seeing through windows.

Arguably, the most noteworthy finding in this study was that blind children showed more grasp of the straight-line rule than did the sighted children, who performed at surprisingly low levels on both statements that addressed the effects of angle on vision. It was suggested that blind children ask more direct questions about this and thus have a declarative knowledge about it that facilitates understanding of this being a hard-and-fast rule. Sighted children, on the other hand, may not pay so much attention to verbal information about the straight-line rule, and may continue to believe, for longer than previously thought, that although lines of sight are *expected* to be straight they are not *always* and *unavoidably* straight (Boydell et al., 2003 and Flavell et al., 1991 found evidence of this in sighted three-year-olds).

Although the blind children in Study 4 demonstrated more knowledge than the sighted children about the straight-line rule, and similar levels of knowledge for 13 of the 16 statements about vision, the fact remains that a large body of research has found that blind children do not perform as well as their sighted peers on visual perspective-taking tasks, suggesting that they find it difficult to apply what they know about

vision to situations that they are presented with in research environments. With this in mind, the next study, reported in **Chapter 11**, aimed to provide a more naturalistic setting than has previously been used for blind children to demonstrate their knowledge about vision. Hiding skills are thought to reflect understanding of what is seen by another person (Flavell et al., 1978), and Study 5 employed a ready-made scenario in which a variety of hiding places, some appropriate and some not, was available to 13 congenitally blind children aged between 3;10 and 11;8. The hypothesis stated that the provision of a number of hiding places would enable blind children to select one of three (out of a possible eight) locations that were appropriate for successful hiding, thus putting into practice what they knew about vision. The results supported the hypothesis, with even the youngest children hiding successfully.

Thus, the picture that emerged as the studies evolved was that the blind children who had participated in the empirical work possessed rich information about vision and spoke the language of vision with fluency and accuracy. Also, the opinions that they held about factors that influence vision were similar to the opinions of the sighted children who participated in the studies. Their performance on a visual perspective-taking task was significantly poorer than the performance of the sighted children on the same task, but when provided with appropriate materials and given the opportunity to select from a range of options, they were able to hide themselves with great success – an accomplishment that is believed to reflect the ability to take the visual perspective of another person (Flavell et al., 1978). This raises the question as to how congenitally blind children acquire these skills in the absence of visual experience.

The final empirical study, reported in **Chapter Twelve**, aimed to shed some light on how skills of this type might be developed through consideration of some social influences upon the development of understanding of vision and the language of vision. Parents and educators of blind children were interviewed, and they described many situations, both planned and naturally occurring, in which social experiences and conversation may have contributed to the development of the blind children's knowledge and understanding of vision. Additionally, they gave numerous examples of how the children had demonstrated understanding of visual concepts through language and behaviour.

13.3. Implications of findings

In the early chapters of this thesis, it was shown that vision is implicated in theories of development of understanding of aspectuality and visual perspective-taking. Some of the literature on the relationship between vision and theory of mind was also reviewed. The following sections will outline the implications of the findings for each of these areas of development.

13.3.1. Implications of findings for the theoretical framework of developing understanding of aspectuality

Section 2.3. provided an account of the developmental pathway proposed by O'Neill, Astington and Flavell (1992) which argues that the development of understanding of aspectuality passes through three stages, at the end of which children possess a secure understanding of how their own and other's knowledge is dependent on the type and extent of informational access. The first stage, or Level 1, is known as the associative stage and occurs around three to four years of age in sighted children. In this stage,

sighted children demonstrate some understanding of the *association* between knowledge and sensory experience, but only in the visual modality (O'Neill & Gopnik, 1991; Perner, 1991). During this stage of development, children do not understand the causal relationship between sensory experience and knowledge. Questions were raised as to how this stage might be manifest in children who are congenitally blind, given that for sighted children, the association that they first understand is the association between seeing and knowing. Chapter Seven reported some evidence of blind children's over-estimation of knowledge to be gained from touch, and this indicates that the associative stage for blind children may be manifest in the relationship between touching and knowing.

13.3.2. Implications of findings for the theoretical framework of development of visual perspective-taking abilities

The development of visual perspective-taking skills was discussed within the framework of the developmental pathway proposed by Flavell (1978) (Section 4.2.1.). The absence of vision has been reported by many researchers (e.g. Bigelow, 1988, 1991a, 1991b; Hatwell, 1984; Miletic, 1995; Millar, 1976; Nock et al., 2003a, 2003b; Nock et al., 2004) to have a detrimental effect upon the acquisition of visual perspective-taking abilities. The results of Study 2 were in line with previous studies and indicated that sighted children were better than their blind peers at visual perspective-taking. The blind children did however perform at levels well above those expected by chance. They experienced some difficulties with the effects on vision of barriers and orientation, but the effects of distance presented them with the most problems, with several children working on the premise that proximity equals vision, regardless of occlusion and orientation, and that vision is not possible at distances of

15 metres and above. So what are the implications of these findings for theories of development of perspective-taking?

An obvious implication is that the findings provide support for the premise that vision makes an important contribution to the development of visual perspective-taking abilities. Less obviously, we need to consider the results of Studies 3 to 5, and place the results of Study 2 within the context of those findings. Study 3 found that blind children know which factors affect vision, and hold similar opinions to sighted children when prioritising the importance of the factors they were asked to consider in the study. Similarly, the True or False task employed in Study 4 found that blind and sighted children, matched for age and sex, differed significantly in their opinions about only three statements about vision, and their opinions were similar for the remaining 13 statements. This raises questions as to why, when they apparently *know* as much about vision as their sighted peers, blind children do not perform at similar levels to their sighted peers on visual perspective-taking tasks. Why are they not easily able to apply what they know when making predictions about vision?

One possible explanation is that the experimental situation, favoured by so many researchers who have found serious deficits in the perspective-taking abilities of blind children, does not facilitate the performance of such children on perspective-taking tasks. It is enlightening here to recall the work of Brambring (2005), reported in Section 5.2.1., who found evidence for the existence of Level 1 perspective-taking in a congenitally blind three-year-old. The child spontaneously demonstrated her ability whilst carrying out another task and it was only while the researchers were viewing videotapes of her performance on this other task that they noticed the behaviour. It is

possible that blind children's perspective-taking may be embedded within naturally occurring events that go unnoticed by researchers. Artificially produced experimental situations may be confusing and hard to grasp, thus impeding blind children's performance, and with this in mind Study 5 attempted to create a more naturalistic scenario in which to explore the perspective-taking abilities of blind children. As expected, the majority of children in this study, including a three-year-old and a five-year-old, demonstrated that they were able to apply what they knew about vision in order to hide themselves successfully from a sighted observer. As discussed in Sections 4.2. and 6.2.1.2. Donaldson (1978) pointed out that the materials used by Piaget (1956), when investigating visual perspective-taking in children, were unfamiliar and the task was arbitrary. When provided with the right conditions and materials, three- and four-year-old sighted children demonstrated understanding of the perspective of another, challenging Piaget's assertions that this is not possible until the age of eight or nine years (Borke, 1971; Hughes & Donaldson, 1979). The issue of meaningful materials and concepts was considered further in Section 6.2.1.2. (e.g. Minter et al., 1998; Peterson et al., 2000). One of the most important implications of this thesis is that it further confirms the findings of others about the importance of using 'methods fit for purpose' (Lewis & Collis, 2005), and the value of bearing in mind that the child negotiates meaning and understanding in a social context.

So, in terms of implications for theories of visual perspective-taking, it would seem that the findings of Study 5, combined with the findings of Brambring (2005), Peterson et al. (2000) and Landau and Gleitman (1985) cast doubt upon the position that Level 1 perspective-taking is not present in blind children until the age of at least six or seven years (e.g. Bigelow, 1992; Fraiberg, 1977; Landau & Gleitman, 1985),

and in the case of Farrenkopf and Davidson (1992), not until the age of nine to ten years or even later.

13.3.3. Implications of findings for the links between congenital blindness and the acquisition of a theory of mind

The findings of many studies indicate that a theory of mind is present in typically developing children by the age of around four to five years. The impact of congenital blindness on the acquisition of a theory of mind has been the focus of a number of studies (e.g. Green et al., 2004; McAlpine & Moore, 1995; Minter et al., 1998; Peterson et al., 2000; Roch-Levecq, 2006), which have generally concluded that blind children are delayed in understanding the false beliefs of others. McAlpine and Moore (1995) suggested that blind children did not acquire theory of mind, as measured by performance on misleading container tasks, until at least nine years of age, and in the case of Peterson et al. (2000), not until the age of 12 years.

The blind children who participated in Study 1 demonstrated an understanding of mind earlier than has been found in other studies, suggesting that the development of theory of mind in congenitally blind children may not be as delayed as was previously thought.

Alternatively, it is possible that the blind children who took part in Study 1 were facilitated in their understanding of mind by exposure to a rich linguistic and social environment from an early age through their attendance in mainstream, rather than special schools. Peterson et al. (2000), who found evidence for delayed theory of mind in blind children, reported that the children they studied were selected from

special units for the blind. While this is by no means a certain causal factor, and is in no way intended to suggest that special schools are inferior to mainstream schools, it is an area that is worth investigating further, as it has implications for the debate on inclusive education.

An additional factor that needs consideration is the high verbal IQ of the blind children who participated in Study 1. This, rather than the school environment may have contributed to their early understanding of mind. Whichever explanation is valid, and it is beyond the scope of this thesis to explore the matter further, it is clear that blind children are not, of necessity, unable to understand the minds of others until between the ages of nine (McAlpine & Moore, 1995) to twelve (Peterson et al., 2000) years.

13.3.4. General implications

There are several more general implications that the research reported in this thesis raise. First, the possible application of the rules of their own intact modalities, particularly touch and audition, seems to cause some confusion for blind children when performing visual perspective-taking tasks, and the comments of parents and educators in response to the question “Do you think C’s experience of the other senses (touch, hearing, smell and taste) helps him/her to understand about vision and seeing?” (Study 6) supports this position.

Second, blind children demonstrated more accurate knowledge of the straight-line rule compared to the sighted children in Study 4. This suggests that sighted children may continue to believe for longer than previously thought that although lines of sight

are *expected* to be straight they are not *always* and *unavoidably* straight. Boydell et al. (2003) and Flavell et al. (1991) found evidence of this in sighted three-year-olds, but the oldest sighted child in Study 4 to express some confusion about the straight-line rule was aged 14 years.

Third, the blind children participating in the empirical studies reported in this thesis showed a remarkable understanding about some of the factors that affect vision, for example distance, barriers and orientation. They were not, however, always able to put what they knew into practice when carrying out the visual perspective-taking task in Study 2. This has implications for the ways in which blind children are taught about vision. Many parents and educators interviewed in Study 6 expressed regret that until the interview they had not given any thought to explicit instruction about vision and visual concepts. It seems appropriate to suggest that the current approach to teaching blind children about vision is insufficient, based as it is on the science curriculum, which is targeted primarily at sighted children. New methods that actually provide real-life perspective-taking scenarios, complete with corrective feedback, need to be developed to facilitate development of understanding about the nuances and parameters of vision.

This said, the more naturalistic approach employed in Study 5 yielded results that indicate that many blind children are able to put what they know about vision into practice in order to hide themselves successfully from a sighted observer. This finding will inform theoretical explanations of the development of visual perspective-taking in blind children, and this in itself holds implications for methodology. The performance of even the youngest children in the Hide-and-Seek task was quite

remarkable, and was in sharp contrast to the findings of Study 2, where the task was much more artificial, and the instructions may have been difficult for the children to understand. The task in Study 2 was also arguably less motivating for the participants.

Two final implications that will be raised relate to the education of blind children within mainstream schools, both of which were mentioned by educators interviewed in Study 6, viz. the placement of blind children within low ability groups and the content of RE lessons where healing the blind is the central concept. First, it is entirely inappropriate for children with physical impairments such as blindness to be considered to have learning disabilities, defined in The Children Act (DfES, 2004) as ‘a state of arrested or incomplete development of mind which induces significant impairment of intelligence and social functioning’ (Ch.31, Pt.1, Section 9), and this is an area that needs careful monitoring by inclusion managers and parents alike. Second, while teaching about healing miracles is appropriate, more careful thought needs to be given to how this can best be done without causing distress to pupils with impairments. The words of the teacher of seven-year-old D (E75), reported in Chapter Twelve provide useful advice for educators:

“I’m not saying that we shouldn’t teach them about this, just that we need to think carefully about their age and their ability to deal with it. And also, to think about how we’re going to deal with any distress or confusion it might cause.”

There is no intention to suggest that misplacement of blind children within ability groups and insensitivity to children with impairments are common in educational settings, but these issues are mentioned because they do have serious implications for the well-being of blind pupils at school.

13.4. Limitations of the thesis

One limitation of this thesis is that it was difficult to furnish a fully comparative analysis of the data because, with the exception of Studies 4 and 5, there was a discrepancy in the sample size of congenitally blind and sighted children. In research of this nature, it is of course extremely difficult to recruit a large sample of congenitally blind children with no known additional cognitive or physical impairments (see Section 6.4.2.), even though the recruitment levels for this thesis were high (16 in total) in comparison to other research investigating similar populations. In view of this, however, caution needs to be taken when interpreting the results, in particular when drawing generalisations, for example, from the finding that blind children reach proficiency in understanding about aspectuality at around 7½ years of age. Only three blind children in Study 1 were this age, and thus, it is wise to interpret the findings with prudence.

Another limitation concerns the nature of the family backgrounds of the congenitally blind children, which may be atypical of that population. The recruitment process targeted teachers of visually impaired children, who were asked to forward the introductory letter to families of blind children whom they deemed to meet the research criteria (see Appendix 2A). Unavoidably, this selection process tended to filter out those families whom the teachers considered to be unsuitable either because they perceived, rightly or wrongly, that the families would be unreliable or reluctant to participate. Additionally, some teachers expressed the view that whilst they knew of a child who met the criteria, they felt that the family of that child “had enough on their plate already, without taking on extra demands and commitments” or similar. The ramifications of this are that the sample recruited may not be fully representative

of that population. The blind children who were included in the research may have differed greatly in their experiences and environment, for example, through attending mainstream schools and mixing mainly with sighted peers, thus developing an understanding of vision that is not typical of blind children who attend special school.

Of those children who were recruited it would seem that they came from families who manifested a rich linguistic environment (see extracts from interviews in Study 6), which may have been a contributory factor in the high verbal IQ scores of the blind children (see Section 6.5.2.), although this was not significantly higher than the sighted children's scores.

Sampling issues presented some further problems in that any sample made up entirely of volunteers may differ from the population (Ora, 1965). The recruitment process for sighted children was different in that families had to opt out of the process (see Appendix 2B) rather than reply to an individual letter stating interest. The families of sighted children can still be classified as volunteers but their initial response was passive rather than active.

The procedures used in Study 2 were rather artificial – a criticism that was levelled at Bigelow a number of times in the thesis. By contrast, and with hindsight, as the research proceeded, the methodology became more sophisticated as evidenced in Study 5, the Hide-and-Seek task. This task, which was highly motivating and enjoyable for the children, and further, attempted to provide a naturalistic setting, elicited excellent responses from the children, and enabled them to put what they knew about vision into practice.

13.5. Directions for future research

Section 2.5. reported that participation in a specially designed curriculum unit on perception enabled children as young as five years to progress toward a more “scientifically accurate understanding of perception” (Massey & Roth, 1997, p.10). Future work could investigate whether exposure to such an approach could accelerate understanding of the aspectuality of knowledge in children younger than five years. The outcomes of such a study would contribute to the debate about whether increasing maturity of the frontal lobes and theory of mind are necessary prerequisites to understanding about aspectuality.

Although much research has been carried out into Level 1 and Level 2 perspective-taking, there is a lack of research with sighted and blind children about the development of explicit knowledge about the conditions under which vision is blurred or indistinct (for example, in poor light), or that embedded figures may require visual search because they blend with the background. Future research in this area would be very useful, and could reveal which misunderstandings can be attributed to blindness and which are common areas of misunderstanding.

The identification of blind children’s possible spontaneous analogies to other sensory modalities was a by-product of Study 2 and the methodology was not designed specifically to investigate this phenomenon. Given that the use of such analogies would appear to be helpful to blind children when the rules of the modality upon which they draw coincide with visual rules, but confusing when they do not, future research could look at the impact of correctional instruction about cross-modal

analogies, for example, by using a programme such as that designed by Massey and Roth (1997).

In view of the fact that evidence of theory of mind was found in blind children at an earlier age than has previously been recognised, this is an area that would benefit from further investigation. It was beyond the scope of the empirical studies reported here to pursue this matter further, but the issue of mainstream versus special school for children with congenital blindness was briefly referred to, because the blind children in the studies reported in this thesis all attended mainstream schools. By contrast, the blind participants in Peterson et al. (2000), who were reported to have delays in the acquisition of theory of mind, were selected from special units for the blind. While this is by no means a certain causal factor, it is an area that is worth investigating further, as it has implications for the debate on inclusive education. Research might focus on investigating linguistic development as well as theory of mind, and comparing groups from mainstream and special schools.

More naturalistic methods for exploring perspective-taking abilities in blind children might yield informative data. For example, naturalistic observations (e.g. Newton, Reddy, & Bull, 2000) in a range of settings, such as in the classroom, playground, home environment or park, looking for evidence of embedded perspective-taking skills, as reported by Brambring (2005), might produce evidence that would not be manifest in formal experimental contexts. Similarly, diary studies could be utilised, and could include parents and educators, who have a great deal of access to the children, and could thus provide an excellent source of rich descriptive data, see for example Robinson and Mervis (1999). Some research regarding the placement of

children with physical impairments, including blindness, but no additional learning difficulties within ability groups in the classroom would be most beneficial. If there is a trend towards placing such children in lower-ability groups, as reported by three participants in Study 6, awareness of the inappropriateness of this needs to be raised amongst educational practitioners and managers.

Finally, Section 13.3.4. noted that the current approach to teaching blind children about vision is insufficient, based as it is on a science curriculum that is targeted primarily at sighted children. By extension, such concerns appertain to the entire National Curriculum in regard to its planning, implementation and commitment to the values of inclusive education. With this in mind, it is suggested that research could consider the adaptation and revision of the National Curriculum to address the needs of all children, including those with impairments.

In conclusion, this thesis reports a number of important findings about blind and sighted children's understanding of vision, and demonstrates that more naturalistic methodologies produced better performance in blind children on both theory of mind and visual perspective-taking tasks.

REFERENCES

- Adamson, L. B., & Ronski, M. A. (Eds.). (1997). *Communication and Language Acquisition: Discoveries from Atypical Development*. Baltimore, Matyland: Paul H. Brookes Publishing Co.
- Andersen, E. S., Dunlea, A., & Kekelis, L. S. (1984). Blind children's language: Resolving some differences. *Journal of Child Language*, 11, 645-664.
- Ashmead, D. H., Wall, R. S., Eaton, S. B., Ebinger, K. A., Snook-Hill, M. M., Guth, D. A., et al. (1998). Echolocation reconsidered: Using spatial variations in the ambient sound field to guide locomotion. *Journal of Visual Impairment & Blindness*, 92, 615-632.
- Ashmead, D. H., Wall, R. S., Ebinger, K. A., Eaton, S. B., Snook-Hill, M. M., & Yang, X. (1998). Spatial hearing in children with visual disabilities. *Perception*, 27, 105-122.
- Astington, J. W. (1993). *The child's discovery of the mind*. Cambridge, MA: Harvard University Press.
- Baillargeon, R., & DeVos, J. (1991). Object permanence in young infants: Further evidence. *Child Development and Psychopathology*, 62, 1227-1246.
- Baillargeon, R., Spelke, E., & Wasserman, S. (1985). Object permanence in 5 month old infants. *Cognition*, 20, 191-208.
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have theory of mind? *Cognition*, 21, 37-46.
- Batki, A., Baron-Cohen, S., Wheelwright, S., Connelan, J., & Ahluwalia, J. (2000). Is there an innate gaze module/ Evidence from human neonates. *Infant behaviour and development*, 23, 223-229.
- Bayley, N. (1969). *Bayley Scales of Infant Development*. New York: Psychological Corporation.
- Bell, J. (2001). *Doing Your Research Project (3rd ed.)*. Buckingham: Open University Press.
- Bigelow, A. E. (1988). Blind children's concepts of how people see. *Journal of Visual Impairment & Blindness*, 82, 65-68.
- Bigelow, A. E. (1991a). The effects of distance and intervening obstacles on visual inference in blind and sighted children. *International Journal of Behavioral Development*, 14(3), 273-283.
- Bigelow, A. E. (1991b). Hiding in blind and sighted children. *Development and Psychopathology*, 3, 301-310.
- Bigelow, A. E. (1991c). Spatial mapping of familiar locations in blind children. *Journal of Visual Impairment and Blindness*, 85, 113-117.
- Bigelow, A. E. (1992). Blind children's ability to predict what another sees. *Journal of Visual Impairment & Blindness*, 86, 181-184.
- Bigelow, A. E. (1996). Blind and sighted children's spatial knowledge of their home environments. *International Journal of Behavioral Development*, 19, 797-816.
- Binnie, L. M., & Williams, J. M. (2002). Intuitive psychological, physical and biological knowledge in typically developing preschoolers, children with autism and children with Down's syndrome. *British Journal of Developmental Psychology*, 20, 343-359.
- Bischof-Kohler, D. (Ed.). (1991). *The development of empathy in infants*. Hillsdale, N.J.: Erlbaum.
- Bishop, D., & Mongford, K. (Eds.). (1993). *Language Development in Exceptional Circumstances (2nd ed.)*. Hove, Sussex: Earlbaum.

- Borke, H. (1971). Interpersonal perception of young children: egocentrism or empathy. *Child Development*, 5, 263-269.
- Bouvier, J. V., & Sinha, P. (2006). *Visual Object Concept Discovery: Observations in Congenitally Blind Children, and A Computational Approach*. Unpublished manuscript, Massachusetts.
- Bower, T. G., Broughton, J., & Moore, M. K. (1971). Development of the object concept as manifested in changes in the tracking behavior of infants between 7 and 20 weeks of age. *Journal of Experimental Child Psychology*, 11(2), 182-193.
- Boydell, M., Campbell, R., & Doherty, M. (2003). Seeing round corners: Children's understanding of line of sight. *Paper presented at the British Psychological Society Developmental Section Annual Conference, at Coventry, UK.*
- Brambling, M. (2005). Perceptual perspective taking in children who are blind: The state of research and a single-case study. *The British Journal of Visual Impairment*, 23(3), 122 - 127.
- Breakwell, G. M. (Ed.). (1995). *Interviewing*. London: SAGE Publications.
- Bridges, A., & Rowles, J. (1985). Young children's projective abilities: What can a monster see? *Educational Psychology*, 5, 251-266.
- Briggs, S. (2004). *Inclusion and how to do it: Meeting SEN in Secondary Classrooms*. London: David Fulton Publishers Ltd.
- Brislin, R. W., & Leibowitz, H. W. (1970). The effect of separation between test and comparison on size constancy at various age-levels. *American Journal of Psychology*, 73, 119-213.
- Brown, R., & Bellugi, U. (Eds.). (1964). *Three processes in the child's acquisition of syntax*. Cambridge, Mass.: MIT Press.
- Butler, S. C., Caron, A. J., & Brooks, R. (2000). Infant understanding of the referential nature of looking. *Journal of cognition and development*, 1, 359-377.
- Butterworth, G., & Cochran, E. (1980). Towards a mechanism of joint visual attention in human infancy. *International Journal of Behavioural Development*, 3, 253 - 270.
- Butterworth, G., & Jarrett, N. (1991). What minds have in common is space: spatial mechanisms serving joint visual attention in infancy. *British Journal of Developmental Psychology*, 9, 55-72.
- Carey, K. (2002). The colour of sound and the soundness of colour. *British Journal Of Visual Impairment*, 20(2), 80-83.
- Cicchetti, D., & Stroufe, L. A. (Eds.). (1978). *An organization view of affect: Illustration from the study of Down's syndrome infants*. New York: Plenum.
- Clark, J. C. (2003). *Practical activities: What science teaching can learn from primary classrooms*. Paper presented at the Annual Conference of NZARE/AARE, Auckland.
- Collis, G. M., Lewis, V., Nock, J. A., Twiselton, R., & Burns, J. M. (2004). How the social environment provides blind children with information about space. In S. H. Ballesteros, M. (Ed.), *Touch, Blindness, and Neuroscience*. Madrid: UNED Varia.
- Corkum, V., & Moore, C. (1998). Origins of visual attention in infants. *Developmental Psychology*, 34, 28-38.
- Cox, M. (1986). *The child's point of view*. Brighton: Harvester.
- Day, R. H., & McKenzie, B. E. (1981). Infant perception of the invariant size of approaching and receding objects. *Developmental Psychology*, 17, 670-677.

- DfEE. (2000). *Science The National Curriculum for England, Key stages 1-4*: Stationery Office.
- DfES. (2003). *Every Child Matters*: Stationery Office.
- DfES. (2004). *The Children Act*: Stationery Office.
- Donaldson, M. (1978). *Children's minds*. London: Fontana.
- Dretske, F. I. (1969). *Seeing and Knowing*. Chicago: University of Chicago Press.
- Dretske, F. I. (1981). *Knowledge and the flow of information*. Cambridge, MA: MIT Press.
- Dunn, J. (1994). Changing minds and changing relationships. In C. Lewis & P. Mitchell (Eds.), *Origins of an understanding mind*. Hove: Earlbaum.
- Dunphy-Lelii, S., & Wellman, H. M. (2004). Infant's understanding of occlusion and other's line-of-sight: Implications for an emerging theory of mind. *European Journal of Developmental Psychology*, 1(1), 49-66.
- Durkin, K. (1995). *Developmental Social Psychology: From Infancy to Old Age*. Oxford: Blackwell Publishers.
- Fabes, R. A., & Filsinger, E. E. (1986). Olfaction and young children's preferences: A comparison of odor and visual cues. *Perception and Psychophysics*, 40, 171-176.
- Fabricius, W., Schick, K., Prost, J., & Schwanenflugel, P. (1997). *We don't see eye-to-eye: Development of a constructivist theory of mind*. Paper presented at the Society for research in child development, Washington, DC.
- Farrenkopf, C., & Davidson, I. F. W. K. (1992). The development of perspective-taking abilities in young blind children. *Re:View*, 24(1), 7-23.
- Flavell, J. H. (Ed.). (1978). *The development of knowledge about visual perception*. Lincoln: University of Nebraska Press.
- Flavell, J. H. (Ed.). (2004). *Development of knowledge about vision*. London: MIT Press.
- Flavell, J. H., Botkin, P., Fry, C., Wright, J., & Jarvis, P. (1968). *The development of role-taking and communication skills in children*. New York: Wiley.
- Flavell, J. H., Everett, B. A., Croft, K., & Flavell, E. R. (1981). Young children's knowledge about visual perception: further evidence for the level 1 – level 2 distinction. *Developmental Psychology*(17), 99-103.
- Flavell, J. H., Flavell, E. R., Green, F. L., & Wilcox, S. A. (1980). Young children's knowledge about visual perception: Effects of observer's distance from target on perceptual clarity of target. *Developmental Psychology*, 16(10-12).
- Flavell, J. H., Green, F. L., Herrera, C., & Flavell, E. R. (1991). Young children's knowledge about visual perception: Lines of sight must be straight. *British Journal of Developmental Psychology*, 9, 73-87.
- Flavell, J. H., Shipstead, S. G., & Croft, K. (1978). Young children's knowledge about visual perception: Hiding objects from others. *Child Development*, 49, 1208-1211.
- Flavell, J. H., Shipstead, S. G., & Croft, K. (1980). What young children think you see when their eyes are closed. *Cognition*, 8, 369-387.
- Fraiberg, S. (1968). Parallel and divergent patterns in blind and sighted infants. *Psychoanalytic Study of the Child*, 23, 264-300.
- Fraiberg, S. (1977). *Insights from the blind*. New York: Basic Books.
- Fraiberg, S., & Adelson, E. (1975). Self-representation in language and play: Observations of blind children. *Psychoanalytic Quarterly*, 42, 539-562.

- Gopnik, A., & Graf, P. (1988). Knowing how you know: Young children's ability to identify and remember the sources of their beliefs. *Child Development*, 59, 1366-1371.
- Gopnik, A., Slaughter, V., & Meltzoff, A. N. (Eds.). (1994). *Changing your views: How understanding visual perception can lead to a new theory of the mind*. Hove: Earlbaum.
- Granrud, C. E. (Ed.). (2004). *Visual Metacognition and the Development of Size Constancy*. London: MIT Press.
- Granrud, C. E., & Morreale, M. A. (2001). *The role of perceptual knowledge in the development of size constancy*. Paper presented at the Society for Research in Child Development, Minneapolis.
- Green, S., Pring, L., & Swettenham, J. (2004). An investigation of first-order false belief understanding of children with congenital profound visual impairment. *British Journal of Developmental Psychology*, 22, 1-17.
- Gzesh, S. M., & Surber, C. F. (1985). Visual perspective-taking skills in children. *Child Development*, 56, 1204-1213.
- Hatton, D. D., Bailey, D. B., Burchinal, M. R., & Ferrell, K. A. (1997). Developmental growth curves of preschool children with vision impairments. *Child Development*, 68, 788-806.
- Hatwell, Y. (1984). *Piagetian reasoning and the blind (English ed.)*. New York: American Foundation for the Blind.
- Hatwell, Y., Orliaguet, J. P., & Brouty, G. (Eds.). (1990). *Effects of objects properties, attentional constraints and manual exploratory procedures on haptic perceptual organization: A developmental study*. New York: Kluwer Academic/Plenum Publishers.
- Hood, B., Willen, D., & Driver, J. (1998). Adult's eyes trigger shifts of visual attention in human infants. *Psychological Science*, 9(131-134).
- HPMEC. (2006). *Ethical Principles for Research Involving Human Participants*, from <http://www.open.ac.uk/research-ethics/index.shtml>
- Hughes, M., & Donaldson, M. (1979). The use of hiding games for studying the co-ordination of viewpoints. *Educational Review*, 31, 133-140.
- Junefelt, K. (2004). Identity and development: Lessons learned from a blind child. *Topics in Language Disorders*, 24(3), 187-199.
- Kleeman, J. (1973). The Peek-A-Boo game: Its evolution and associated behavior, especially byebye and shame expression during the second year. *Journal of the American Academy of Child Psychiatry*, 12(1), 1-23.
- Kloo, D., & Perner, J. (2003). Training transfer between card sorting and false belief understanding: helping children apply conflicting descriptions. *Child Development*, 74(6), 1823-1839.
- Kyle, J. G., & Allsop, L. (1982). Communicating with young deaf people. *Teacher of the Deaf*, 6(89-95).
- Landau, B., & Gleitman, L. (1985). *Language and experience: Evidence from the Blind Child*. Cambridge: Harvard University Press.
- Leibowitz, H. W. (1974). Multiple mechanisms of size perception and size constancy. *Hiroshima Forum for Psychology*, 1, 47-53.
- Lempers, J. D., Flavell, E. R., & Flavell, J. H. (1977). The development in very young children of tacit knowledge concerning visual perception. *Genetic Psychology Monographs*, 95, 3-53.

- Lessard, N., Pare, M., Lepore, F., & Lassonde, M. (1998). Early-blind human subjects localize sound sources better than human subjects. *Nature*, 395, 278-280.
- Lewis, V. (2003). *Development and Disability (2nd ed.)*. Oxford: Blackwell Publishers.
- Lewis, V., & Collis, G. (Eds.). (2005). *Blind children and children with autism: Research methods fit for purpose*. London: Wiley.
- Lewis, V., Collis, G., Shadlock, R., Potts, M., & Norgate, S. (2002). New methods for studying blind children's understanding of familiar space. *British Journal of Visual Impairment*, 20(1), 17-23.
- Lewis, V., Collis, G. M., Nock, J. A., Twiselton, R., & Burns, J. M. (2004). Blind children's understanding of the euclidean properties of space. In S. H. In Ballesteros, M. (Ed.), *Touch, Blindness, and Neuroscience*. Madrid: UNED Varia.
- Lewis, V., Norgate, S. H., Collis, G. M., Lewis, V., Nock, J.A., Twiselton, R. & Burns, J.M., & Reynolds, R. (2000). The consequences of visual impairment for children's symbolic and functional play. *British Journal of Developmental Psychology*, 18(449-464).
- Masangkay, Z. S., McCluskey, K. A., Curtis, W., Sims-Knight, J., Vaughn, B. E., & Flavell, J. H. (1974). The early development of inferences about the visual percepts of others. *Child Development*, 45, 357-366.
- Massey, C., & Roth, Z. (1997, April). *Feeling Colors and Seeing Tastes: Kindergartners' Learning about Sensory Modalities and Knowledge Acquisition*. Paper presented at the biennial meeting of the Society for Research in Child Development, Washington, D.C.
- Maurer, D., & Salapatek, P. (1976). Developmental changes in the scanning of faces by young infants. *Child Development*, 47, 523-527.
- McAlpine, M. L., & Moore, C. L. (1995). The development of social understanding in children with visual impairments. *Journal of Visual Impairment & Blindness*, 89(4), 349-358.
- McGuigan, N., & Doherty, M. (2005). Head and shoulders, knees and toes: Which parts of the body are necessary to be seen? *British Journal of Developmental Psychology*, *In Press*.
- McGuigan, N., & Doherty, M. J. (2002). The relation between hiding skill and judgment of eye direction in preschool children. *Developmental Psychology*, 38(3), 418-427.
- Mehler, J., & Dupoux, E. (1994). *What infants know: The new cognitive science of early development*. Oxford: Blackwell Publishers Ltd.
- Meltzoff, A. N., & Borton, R. W. (1979). Intermodal matching by human neonates. *Nature*, 282, 403-404.
- Miles, M. B., & Hubberman, A. M. (1994). *Qualitative data Analysis (2nd ed.)*. Thousand Oaks, CA: Sage Publications.
- Miletic, G. (1995). Perspective taking: Knowledge of level 1 and level 2 rules by congenitally blind, low vision, and sighted children. *Journal of Visual Impairment & Blindness*, 88, 514-523.
- Millar, S. (1976). Spatial representation by blind and sighted children. *Journal of Experimental Child Psychology*, 21, 260-279.
- Miller, P. H., & Bigi, L. (1977). Children's understanding of how stimulus dimensions affect performance. *Child Development*, 48, 1712-1715.
- Mills, A. (Ed.). (1988). *Visual handicap*. London: Churchill Livingstone.

- Minter, M., Hobson, R. P., & Bishop, M. (1998). Congenital visual impairment and theory of mind. *British Journal of Developmental Psychology*, 16, 183-196.
- Moll, H., & Tomasello, M. (2006). Level 1 Perspective-taking at 24 months of age. *British Journal of Developmental Psychology*, 24, 603-613.
- Moore, C., & Corkum, V. (1994). Social understanding at the end of the first year of life. *Developmental Review*, 14, 349-372.
- Moscovitch, M. (1995). Confabulation. In J. T. C. D. L. Schacter, G. D. Fischbach, M. Mesulam & L. E. Sullivan (Eds.), *Memory distortion: How minds, brains and societies reconstruct the past* (pp. 226-224). Cambridge, MA: Harvard University Press.
- Mossler, D. G., Marvin, R. S., & Greenberg, M. T. (1976). Conceptual perspective taking in 2- to 6-year-old children. *Developmental Psychology*, 12, 85-86.
- Mulderij, K. J. (2000). Dualistic notions about children with motor disabilities: Hands to lean on or to reach out? *Qualitative Health Research*, 10, 39-50.
- Naveen, K. V., Srinivas, R. S., Nirmala, K. S., Nagendra, H. R., & Telles, S. (1998a). Differences between congenitally blind and normally sighted subjects in the P1 component of middle latency auditory evoked potentials. *Perceptual and Motor Skills*, 86, 1192-1194.
- Naveen, K. V., Srinivas, R. S., Nirmala, K. S., Nagendra, H. R., & Telles, S. (1998b). Middle latency auditory provoked potentials in congenitally blind and normal sighted subjects. *International Journal of Neuroscience*, 90(1-2), 105-111.
- Newton, P., Reddy, V., & Bull, R. (2000). Children's everyday deception and performance on false-belief tasks. *British Journal of Developmental Psychology*, 18(2June), 297-317.
- Nock, J. A., Lewis, V., Collis, G. M., & Burns, J. M. (2003a, September). *Blind children's understanding of the effects on vision of distance*. Paper presented at the British Psychological Society Developmental Section Annual Conference, Coventry, UK.
- Nock, J. A., Lewis, V., Collis, G. M., & Burns, J. M. (2003b, August). *Blind children's understanding of visual perception*. Paper presented at the European Psychological Developmental Section Conference, Milan, Italy.
- Nock, J. A., Lewis, V., Collis, G. M., Twiselton, R., & Burns, J. M. (2004). Blind children's understanding of vision. In S. Ballesteros & M. Heller (Eds.), *Touch, Blindness, and Neuroscience*. Madrid: UNEDVaria.
- O'Neill, D. K., & Astington, J. W. (1990, April). *Preschoolers' developing understanding of the role sensory experiences play in knowledge acquisition*. Paper presented at the American Educational Research Association, Boston.
- O'Neill, D. K., Astington, J. W., & Flavell, J. H. (1992). Young children's understanding of the role that sensory experiences play in knowledge acquisition. *Child Development*, 63, 474-490.
- O'Neill, D. K., & Chong, S. C. F. (2001). Preschool children's difficulty understanding the types of information obtained through the five senses. *Child Development*, 72(3), 803-815.
- O'Neill, D. K., & Gopnik, A. (1991). Young children's ability to identify the sources of their beliefs. *Developmental Psychology*, 27(3), 390-397.
- Ora, J. P. (1965). *Characteristics of the volunteer for psychological investigations*.
- Perner, J. (1990). Experiential awareness and children's episodic memory. In W. S. a. F. E. Weinert (Ed.), *Interactions among aptitudes, strategies and knowledge in cognitive performance* (pp. 3-11). New York: Springer-Verlag.

- Perner, J. (1991). *Understanding the Representational Mind*. Cambridge, MA: Bradford Books/MIT Press.
- Perner, J. (1992). Grasping the concept of representation: Its impact on 4-year-olds' theory of mind and beyond. *Human Development*, 35, 146-155.
- Perner, J., Leekham, S., & Wimmer, H. (1987). Three-year-olds difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology*, 5, 125-137.
- Peterson, C. C., Peterson, J. L., & Webb, J. (2000). Factors influencing the development of a theory of mind in blind children. *British Journal of Developmental Psychology*, 18, 431-447.
- Peterson, C. C., & Siegal, M. (1998). Changing focus on the representational mind: Concepts of false photos, false drawings, and false beliefs in deaf, autistic and normal children. *British Journal of Developmental Psychology*, 16, 301-320.
- Piaget, J. (1954). *The construction of reality in the child*. New York, NY: Basic Books.
- Piaget, J., & Inhelder, B. (1956). *The child's conception of space*. London: Routledge and Kegan Paul.
- Pillow, H. B. (1988). The development of children's beliefs about the mental world. *Merrill-Palmer Quarterly*, 34, 1-32.
- Pillow, H. B. (1989). Early understanding of perception as a source of knowledge. *Journal of Experimental Child Psychology*, 47, 116-129.
- Pillow, H. B. (1993). Preschool children's understanding of the relationship between modality of perceptual access and knowledge of perceptual properties. *British Journal of Developmental Psychology*, 11, 371-389.
- Pillow, H. B., & Flavell, J. H. (1986). Young children's knowledge about visual perception: projective size and shape. *Child Development*, 57, 125-135.
- Pratt, C., & Bryant, P. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). *Child Development*, 61, 973-982.
- Punch, K. F. (1998). *Introduction to Social Research: Quantitative and Qualitative Approaches*. London: Sage Publications.
- Rabinowitz, J. C., Craik, F. I. M., & Ackerman, B. P. (1982). A processing resource account of age differences in recall. *Canadian Journal of Psychology*, 36, 324-344.
- Rapoport, J. L. (1967). Attitude and size judgement in school age children. *Child Development*, 38, 188-1192.
- Recchia, S. L. (1997). Play and concept development in infants and young children with severe visual impairments: a constructivist view. *Journal of Visual Impairment & Blindness*, 401-406.
- Robinson, B. F., & Mervis, C. B. (1999). Comparing productive vocabulary measures from the CDI and a systematic diary study. *Journal of Child Language*, 26, 177-185.
- Robinson, E. J., Thomas, G. V., Parton, A., & Nye, R. (1997). Children's overestimation of the knowledge to be gained from seeing. *British Journal of Developmental Psychology*, 15, 257-273.
- Roch-Levecq, A. (2006). Production of basic emotions by children with congenital blindness: Evidence for the embodiment of theory of mind. *British Journal of Developmental Psychology*, 24, 507-528.

- Roder, B., & Rosler, F. (2003). Memory for environmental sounds in sighted, congenitally blind and late blind adults: evidence for cross-modal compensation. *International Journal of Psychophysiology*, 50(1-2), 27-39.
- Rosenbluth, R., Grossman, E. S., & Kaitz, M. (2000). Performance of early-blind and sighted children on olfactory tasks. *Perception*, 29, 101-110.
- Sampaio, E. (1989). Is there a critical age for using the sonicguide with blind infants? *Journal of Visual Impairment and Blindness*, 83(2), 105-108.
- Schacter, D. L. (1996). *Searching for memory: The brain, the mind, and the past*. New York: Basic.
- Silbereisen, R. K. (Ed.). (1995). *Soziale Kognition: Entwicklung von sozialem Wissen und Verstehen [Social cognition: Development of social knowledge and understanding]*. Weinheim: Psychologie Verlags Union.
- Slater, A., Mattock, A., & Brown, E. (1990). Size Constancy at birth: Newborn infants' responses to retinal and real size. *Journal of Experimental Child Psychology*, 49, 314-322.
- Smith, L. B. (2000). From knowledge to knowing: Real progress in the study of infant categorization. *Infancy*, 1, 91-98.
- Sodian, B., & Wimmer, H. (1987). Children's understanding of inference as a source of knowledge. *Child Development*, 58, 424-433.
- Spelke, E. S. (1976). Infants' intermodal perception of events. *Cognitive Psychology*, 8, 553-560.
- Spelke, E. S. (1987). The development of intermodal perception. In P. Salapatek & L. Cohen (Eds.), *Handbook of Infant Perception: From perception to Cognition* (Vol. 2, pp. 233-274). Orlando, FL: Academic Press.
- Taylor, M. (1988). Children's ability to distinguish what they know from what they see. *Child Development*, 59, 703-718.
- Thomas, N., & O'Kane, C. (1998). The Ethics of Participatory Research with Children. *Children and Society*, 12(5), 336-348.
- Thomas, N., & O'Kane, C. (2000). Discovering what children think: Connections between research and practice. *British Journal of Social Work*, 30, 819-835.
- Trafton, J. G., Schultz, A. C., Perzanowski, D., Bugajska, M. D., Adams, W., Cassimatis, N. L., et al. (2006). *Children and robots learning to play hide and seek*: Naval Research Laboratory.
- UK. (1998). *The Data Protection Act*: The Stationary Office.
- Ungar, S., Blades, M., & Spencer, C. (1995a). Mental rotation of a tactile layout by young visually impaired children. *Perception*, 24, 891-900.
- Ungar, S., Blades, M., & Spencer, C. (1995b). Visually impaired children's strategies for memorizing a map. *British Journal Of Visual Impairment*, 13, 27-32.
- Ungar, S., Blades, M., & Spencer, C. (1996). The ability of visually impaired children to locate themselves on a tactile map. *Journal of Visual Impairment & Blindness*, 90, 526-535.
- Urwin, C. (1981). Early language development in blind children. *The British Psychological Society Division of Educational and Child Psychology Occasional Papers*(5), 78-93.
- Urwin, C. (Ed.). (1983). *Dialogue and cognitive functioning in the early language development of three blind children*. London: Croom Helm.
- Uzzell, D. (Ed.). (1995). *Ethnographic and Action Research*. London: Sage Publications.
- Wallace, R., Allan, K. L., & Tribol, C. T. (2001). Spatial perspective-taking errors in children. *Perceptual and Motor Skills*, 92(3), 633-639.

- Weinberger, N., & Bushnell, E. W. (1994). Young children's knowledge about about their senses: perceptions and misconceptions. *Child Study Journal*, 24, 209-235.
- Weschler, D. (1990). *Wechler Preschool and Primary Scale of Intelligence - Revised UK ed.* London: The Psychological Corporation.
- Weschler, D. (1992). *Weschler Intelligence Scale for Children 3rd UK ed.* London: Psychological Corporation.
- Wimmer, H., Hogrefe, J., & Perner, J. (1988). Children's understanding of informational access as a source of knowledge. *Child Development*, 59, 386-396.
- Wimmer, H., Hogrefe, J., & Sodian, B. (1988). A second stage in children's conception of mental life: Understanding informational accesses as origins of knowledge and belief. In P. L. H. J.W. Astington, & D.R. Olson (Ed.), *Developing theories of mind* (pp. 173-192). Cambridge: Cambridge University Press.
- Wode, H. (Ed.). (1993). *Precursors and the study of the impaired language learner.* London: Croome Helm.
- Woodward, A. L. (2003). Infants' developing understanding of the link between looker and object. *Developmental Science*, 6, 297-311.
- Woolley, J. D., & Bruell, M. J. (1996). Young children's awareness of the origins of their mental representations. *Developmental Psychology*, 37, 335-346.
- www.stats.ox.ac.uk/pub/StatMeth/SM4.pdf. (2007). *Chi-square and Fisher Exact tests*
- Zeigler, H. P., & Leibowitz, H. W. (1957). Apparent visual size as a function of distance for children and adults. *American Journal of Psychology*, 70, 106-109.

APPENDIX 1
RECRUITMENT LETTER SENT TO VI PRACTITIONERS

Address

Date

**Research project: Blind children's understanding of the visual experiences of
sighted people**

Dear Colleague,

I am currently working on the above research project, funded by and based at the Open University. I hope that the research will have implications for the social and spatial development of children who are congenitally blind. Below, I have indicated the characteristics of the children I am seeking, with some details of the project, and I should appreciate it greatly if you would let me know if you know of any children who meet the criteria and are suitable. I should be happy to do this in whatever way you wish. For example, I could let you have an introductory letter to the families asking if they would like to be involved, which you then send to them with a covering letter or whatever you feel would be most appropriate.

Children

I am hoping to recruit at least 12 children between the ages of three and 14 years, who have had light perception or less vision from birth, and have no other known disabilities.

Background

I have been involved in research with blind children for over four years, and have presented research findings at several national and international conferences. I have also contributed a chapter to a book published in 2004, entitled *Touch, Blindness and Neuroscience*. This book was the outcome of an international symposium, which took place at the Universidad Nacional De Educacion A Distanca, Madrid, Spain, in 2002.

Current project

This current project aims to extend previous work, by looking at the way in which blind children develop an understanding of what sighted people see. I am also looking at their understanding of information gained from hearing, smelling, tasting and

touching. In addition, I shall be looking at the contribution of verbal and non-verbal ability. I plan to cause as little disruption as possible to the families of the children involved, and although I should be happy to visit the children at home, if the parents wish, I will more usually work with the children in school, with the prior agreement of the school staff. I shall visit at least three times over the next year to administer various tasks relevant to the research. These tasks are designed to be fun and interesting for the children, and I enjoy good relationships with all the families and children who have contributed to my research.

If you know of any families whose children might be suitable please contact me, either by returning the tear-off slip at the bottom of this letter to the Freepost address given, or by telephone or email. We can then discuss how to go about contacting the families.

I do hope that you will be able to help, and look forward to hearing from you.

Yours faithfully,

Jennifer Nock

I know a child who might be suitable for the research project blind children's understanding of space funded by the Leverhulme Trust and based at the Open University.

Name:

Address:

Telephone:

Email:

APPENDIX 2A

RECRUITMENT LETTER SENT TO PARENTS OF BLIND CHILDREN

Address

Date

Research project: Blind children's understanding of the vision

Dear Parent/Carer,

I am currently working on the above research project, funded by and based at the Open University. I hope that the research will have implications for the social and spatial development of children who are congenitally blind.

Below, I have indicated the characteristics of the children I am seeking, with some details of the project.

Children

I am hoping to recruit at least 12 children between the ages of three and 14 years, who have had light perception or less vision from birth, and have no other known disabilities.

Background

I have been involved in research with blind children for over four years, and have presented research findings at several national and international conferences. I have also contributed a chapter to a book published in 2004, entitled *Touch, Blindness and Neuroscience*. This book was the outcome of an international symposium, which took place at the Universidad Nacional De Educacion A Distancia, Madrid, Spain, in 2002.

Current project

This current project aims to extend previous work, by looking at the way in which blind children develop an understanding of what sighted people see. I am also looking at their understanding of information gained from hearing, smelling, tasting and touching. In addition, I shall be looking at the contribution of verbal ability. I plan to cause as little disruption as possible to the families of the children involved, and although I should be happy to visit the children at home, if the parents wish, I will more usually work with the children in early years settings/school, with the prior agreement of the staff. I shall visit at least three times over the next year to administer

various tasks relevant to the research. These tasks are designed to be fun and interesting for the children, and I enjoy good relationships with all the children who have contributed to my research.

If you think that your child would like to take part in the project, or if you would like more information, please contact me by returning the tear-off slip at the bottom of this letter to the contact address. Alternatively, you can contact me by telephone or email.

I do hope that you will be able to help, and look forward to hearing from you.

Yours faithfully,

Jennifer Nock

I/we, the parent(s) of , **would/would not** be willing for him/her to take part in the Open University research project on blind children's understanding of vision. I/we understand that I/we may withdraw my/our child from the research at any time; and that should I/we so wish, any data provided by my/our child will be destroyed, without fear of resultant adverse consequences.

Signed Date.....

Name:

Address:

Telephone number:

Email:

Child's date of birth:

APPENDIX 2B

RECRUITMENT LETTER SENT TO PARENTS OF SIGHTED CHILDREN

Address

Date

Research project: Blind children's understanding of vision

Dear Parent,

I am currently working on the above research project, funded by and based at the Open University. I hope that the research will have implications for the social and spatial development of children who are congenitally blind, and also increase our knowledge about the development of sighted children.

In the course of this work I am examining the abilities of sighted children, and (*insert name of Headteacher*) kindly agreed to allow me to ask if you would consent to your child taking part in the research programme. The programme involves the administration of a number of practical tasks, which take about (*insert timescale*) in total to complete, and which will be carried out at school or at home, depending on which is most convenient for you. These tasks are designed to be fun and interesting for the children.

If you would like more information about the project do contact me at the Open University.

I do hope that you will be willing to help, and thank you in anticipation.

Yours faithfully,

Jennifer A. Nock.

I/we, the parent(s) of , **would/would not** be willing for him/her to take part in the Open University research project on blind children's understanding of vision. I/we understand that I/we may withdraw my/our child from the research at any time; and that should I/we so wish, any data provided by my/our child will be destroyed, without fear of resultant adverse consequences.

Child's name Signed Date

APPENDIX 2C

RECRUITMENT LETTER SENT TO PARENTS OF SIGHTED CHILDREN

Address

Date

Research project: Blind children's understanding of vision

Dear Parent,

I am currently working on the above research project, funded by and based at the Open University. I hope that the research will have implications for the social and spatial development of children who are congenitally blind, and also increase our knowledge about the development of sighted children.

In the course of this work I am examining the abilities of sighted children, and (*insert name of Headteacher*) has kindly agreed to allow me to ask if you would consent to your child taking part in the research programme. The programme involves the administration of a number of practical tasks, which take about (*insert timescale*) in total to complete, and which will be carried out at school. These tasks are designed to be fun and interesting for the children. I shall be in school on (*insert dates*), to work with the children. If you **do not want** your child to take part, please sign the slip below and return it to school by (*insert date*). If you do not return the slip, I shall assume that you have no objection to your child being included in the project.

If you would like more information about the project do contact me at the Open University.

I do hope that you will be willing to help, and thank you in anticipation.

Yours faithfully,

Jennifer A. Nock.

I/we, the parent(s) of , **would/would not** be willing for him/her to take part in the Open University research project on blind children's understanding of vision. I/we understand that I/we may withdraw my/our child from the research at any time; and that should I/we so wish, any data provided by my/our child will be destroyed, without fear of resultant adverse consequences.

Child's name Signed Date

APPENDIX 2D
REQUEST FOR PARENTAL CONSENT TO VIDEO RECORDING OF
BLIND PARTICIPANTS IN STUDY 5

Address

Date

Research project: Blind children's understanding of the vision

Dear *[insert name]*

In the next stage of the current project, I am hoping to video *[insert child's name]* taking part in a game of hide-and-seek. Videoing the game will allow me to focus on giving verbal support to *[insert child's name]* and free me from making written observations of his/her behaviour during the game.

Access to the video material will be restricted to myself, and once the information on the video has been written up, the recording will be destroyed in accordance with The UK Data Protection Act (1998).

Please complete the tear-off strip at the end of this letter to indicate whether or not this is acceptable to you. If you do consent to the video recording, I shall, of course, also obtain verbal permission from your child's headteacher, if the task is to take place at school.

May I take this opportunity to thank you for allowing *[insert child's name]* to take part in the project to date. We are making excellent progress, and I shall be sure to keep you informed about the findings once the project has been completed.

I shall telephone you within the next few days to discuss any issues that you may want to address, and to arrange an appointment for the hide-and-seek task. As always, this can take place at home or school, whichever is most convenient.

Yours sincerely,

Jennifer Nock

I/we, the parent(s) of, would/would not be willing for him/her to be video recorded while participating in a game of hide-and-seek, for the Open University research project on blind children's understanding about vision. I/we understand that I/we may withdraw my/our child from the research at any time; and that should I/we so wish, any data, including video recordings, provided by my/our child will be destroyed, without fear of resultant adverse consequences.

Name Signed Date.....

APPENDIX 2E

REQUEST FOR CONSENT TO AUDIO RECORDING OF PARTICIPANTS
IN STUDY 6

Address

Date

Research project: Blind children's understanding of the vision

Dear *[insert name]*,

As we discussed when we last spoke, I am planning to interview the parents and educators of the blind children who have participated in this current research project. The interview will be informal in nature, and will aim to investigate how blind children develop an understanding about vision, and how they use visual terms in their language. The process should take less than an hour, and you will be free to say as much or little as you like about each topic addressed.

I am hoping to audio record the interview, as this will free me from making notes during the interview, and will ensure that I can listen well to your responses. Access to the audio material will be restricted to myself, and once the information has been transcribed, the recording will be destroyed in accordance with The UK Data Protection Act (1998).

Please complete the tear-off strip at the end of this letter to indicate whether or not this is acceptable to you. I shall telephone you within the next few days to discuss any issues that you may want to address, and to arrange an appointment for the interview.

Yours sincerely,

Jennifer Nock

I/we, the parent(s) of , **would/would not** be willing to participate in an audio-recorded interview about blind children's understanding about vision. I/we understand that I/we may withdraw from the research at any time; and that should I/we so wish, any data, including audio recordings, will be destroyed, without fear of resultant adverse consequences.

Name Signed Date.....

APPENDIX 3
PROFORMA FOR STUDY 1: BLIND AND SIGHTED CHILDREN'S
UNDERSTANDING ABOUT THE ASPECTUALITY OF KNOWLEDGE
AND ToM

Child's name:

DOB:

Age:

Visual status:

Parent's Name:

Address:

Telephone number:

ASPECTUALITY

Materials

- a blue ball in an opaque bag
- a small bowl of cold water
- a small tape recorder, set at very low volume, so that it has to be held close to the ear in order to hear the cassette of a person talking
- a small brown plastic bottle of colourless bath oil
- a disposable plastic cup of plain water

All of these should be in a box by the experimenter's side, and out of sight of the child.

- a Mister Potato Head doll with detachable eyes, nose, mouth, ears and hands

Procedure

Game 1

Child and researcher in a room that is familiar to the child, seated at a small table. Researcher says:

"Today, we're going to play some games. I'll show you the toys, and then I'll tell you what we're going to do. Does that sound ok?"

Show the MPH doll to the child, and allow the child to explore the toy. Then say:

"I want you tell me the name of these things when I point to them."

Point to each sensory part in turn. After all 5 have been checked, ask:

"Can you point to your (ears) now?" (For VI child without eyes, omit 'eyes').

Sensory part	Named correctly on doll		Identified correctly on self	
Eyes	Yes	No	Yes	No
Ears	Yes	No	Yes	No
Hands	Yes	No	Yes	No
Mouth	Yes	No	Yes	No
Nose	Yes	No	Yes	No

Score first response, praise correct answers (Yes well done! No, think again, what is this called?) Give corrective feedback on response errors. (No, that part is called a nose.)

Say:

"Now I'm going to get some more toys, and we're going to find out different things about each one."

'Touch' trial

Put the bowl of cold water on the table.

Say:

"Here's a bowl of water. Can you find out whether it's warm or cold water and tell me?"

Circle/mark body part used, correct response in bold

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

Say:

"How did you find out that it's cold water?"

touched it put my hand in it with my hand don't know
just know other.....

Say:

"Show me how you found out that it's cold water."

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'Hear' trial

Put the tape recorder on to the table and turn it on. (The volume should be very low.)

Say:

"Here's a tape player. Can you find out whether the tape is music or someone talking and tell me?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

Say:

"How did you find out that it's talking?"

listened to it heard it with my ears don't know just know
other.....

Say:

"Show me how you found out that the tape is someone talking"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'See' trial (Sighted child)

Put the bag containing a ball on to the table.

Say:

"Here's a bag with a ball inside. Can you find out whether the ball is blue or yellow and tell me?"

hand	eyes	mouth	ears	nose
------	-------------	-------	------	------

Record any difficulties, comments and observations.

Say:

"How did you find out that it's blue?"

looked at it saw it with my eyes don't know
just know
other

Say:

"Show me how you found out that the ball is blue."

hand	eyes	mouth	ears	nose
------	-------------	-------	------	------

Record any difficulties, comments and observations.

'See' trial (blind child). * Before administering this task, check with parents that child is not likely to be distressed by final question.

Put the bag containing a ball on to the table.

Say:

"Here's a bag with a ball inside. Let's ask Name to find out whether the ball is blue or yellow."

Name says:

"It's a blue ball."

Record any comments and observations made by blind child

Say:

"How did she/he find out that it's blue?"

looked at it saw it with his/her eyes don't know
just know
other

Record any difficulties, comments and observations.

* Say:

"If you could see, can you show me how you'd find out whether the ball was blue or yellow?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'Smell' trial

Put the bottle of lemon bath oil on to the table.

Say:

"Here's some bubble bath. Can you find out whether it's strawberry bath oil or lemon bath oil and tell me?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

Say:

"How did you find out that it's lemon bath oil?"

smelled it with my nose don't know just know
other.....

Say:

"Show me how you found out that it's lemon bath oil"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'Taste' trial

Put the cup of plain water on the table.

Say:

"Here's some water. Can you find out whether it's sugary water or plain water and tell me?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

Say:

"How did you find out that it's plain water?"

tasted it drank it with my mouth don't know just
know other.....

Say:

"Show me how you found out that it's plain water"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

Game 3

Reintroduce the MPH toy. Say:

"Here is MPH again. Lets see what he needs to find out about the toys."

'Touch' trial

Put the bowl of cold water on the table.

Say:

"Here's a bowl of water. Can you show me what will MPH will need to use to find out whether it's warm water or cold water?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'Hear' trial

Put the tape recorder on to the table and turn it on. (The volume should be very low.)

Say:

"Here's a tape player. Can you show me what will MPH will need to use to find out whether the tape is music or someone talking?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'See' trial

Put the bag containing a ball on to the table.

Say:

"Here's a bag with a ball inside. Can you show me what will MPH will need to use to find out whether the ball is blue or yellow?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'Smell' trial

Put the bottle of lemon bath oil on to the table.

Say:

"Here's some bath oil. Can you show me what will MPH will need to use to find out whether it's strawberry bath oil or lemon bath oil?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

'Taste' trial

Put the cup of plain water to the table.

Say:

"Here's some water. Can you show me what will MPH will need to use to find out whether it's sugary water or plain water?"

hand	eyes	mouth	ears	nose
------	------	-------	------	------

Record any difficulties, comments and observations.

Theory of Mind

Task 1

Changed location

Materials

- 3 pencil cases, tactually different from one another – tin, plastic and fur
- a pen

One other person (adult or sensible child) is needed as a confederate.

Procedure

Child, researcher and confederate in a room that is familiar to the child, seated at a small table. Researcher says:

"Today, we're going to play some games. I'll show you the toys, and then I'll tell you what we're going to do. Does that sound ok?"

Show the child the pen and pencil cases, and allow him/her to explore them tactually, commenting on the texture, shape etc of the pencil cases.

Say:

"C is going to choose a pencil case to keep his/her pen in."

C 'chooses' the furry pencil case and places the pen inside, saying:

"I think I'll put my pen in this one - the furry one."

Sighted child: Watches whilst this takes place, and is then invited to feel inside the furry pencil case to 'check' that the pen is there.

Blind child: Listens to comments, and is then invited to feel inside the furry pencil case to 'check' that the pen is there.

C leaves the room, commenting that he/she is leaving to get something from another room.

Say:

"Let's move the pen to a different pencil case. Take it out of the furry pencil case and put it in the tin pencil case"

Child moves pen. Ask:

"When C comes back, which pencil case will she/he look in for her/his pen?"

tin furry plastic don't know other

Record any difficulties, comments and observations.

Memory check:

1. "Where is the pen now?"

tin furry plastic don't know other

Record any difficulties, comments and observations.

2. "Where was the pen at the beginning?"

tin furry plastic don't know other

Record any difficulties, comments and observations.

3. *"How did the pen get into the tin pencil case?"*

we/I moved it don't know other

Record any difficulties, comments and observations.

4. *"Did C see us move the pen?"*

yes no don't know other

Record any difficulties, comments and observations.

Open explanation:

"Why will C look there?"

- a) mental state*
- b) relevant event facts*
- c) desire answer*
- d) wrong location*
- e) moved it*
- f) irrelevant event*
- g) no answer/don't know*

e.g.

- a) she didn't see me move it*
- b) she put it in the (tin) one*
- c) she wants the pen; she/I like(s) the furry one*
- d) because it's here now*
- e) because we moved it*
- f) she draws with pens*
- g) don't know*

Task 2

Misleading container

Materials

- a CD case
- a plaster

Procedure

Child and researcher in a room that is familiar to the child, seated at a small table. Researcher says:

"Here is a plastic case."

Allow the child to explore the case tactually, but not to open it. Say:

"What do you think is inside the case?"

CD don't know other.

Record any difficulties, comments and observations.

"Why do you think it's a"

Say:

"Would you like to open it and find out if you're right?"

Record any difficulties, comments and observations.

1. Ask:

"What did you think was in the box before you opened it?"

CD don't know other

Record any difficulties, comments and observations.

"Why did you think that?"

2. Ask:

"What would (friend's name) think was in the box if he/she felt it?"

CD don't know other

Record any difficulties, comments and observations.

"Why would think that?"

- a) mental state*
- b) relevant event facts*
- c) desire answer*
- d) (you) moved it/changed it*
- e) wrong location*
- f) irrelevant event*
- g) no answer/don't know*

APPENDIX 4

PROFORMA FOR STUDY 2: BLIND AND SIGHTED CHILDREN'S

UNDERSTANDING OF THE VISUAL AND AUDITORY EXPERIENCE OF

ANOTHER PERSON

Child's Name:

Date:

Child's DoB:

Child's VS:

Location:

Task 1

Predicting when hearing is possible – the effects of distance, barriers and orientation

Materials/procedure:

Small bell

A pair false ears from the MPH doll

One other person (adult or sensible child), the 'listener', who moves to different locations as instructed.

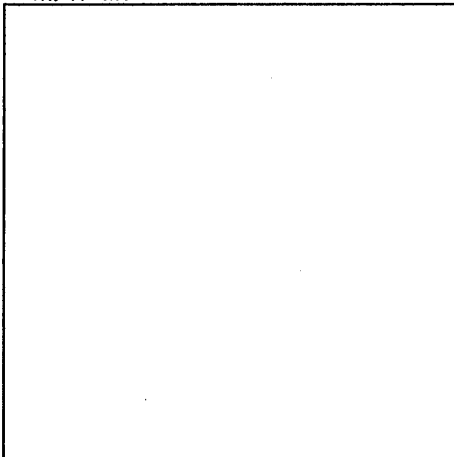
Select all the locations together with the child before starting the trials. Give all the locations a verbal label, e.g. 'In the kitchen' or 'next to the garden shed' and ensure that the child understands the position and the label. Fill in details of locations and barriers on proformae before trials commence. Locations in trials 5 & 6 should be approximately the same distance apart as those in trials 7 & 8 if possible.

Three factors – distance (2 levels), barriers (2 levels) and orientation (3 levels):

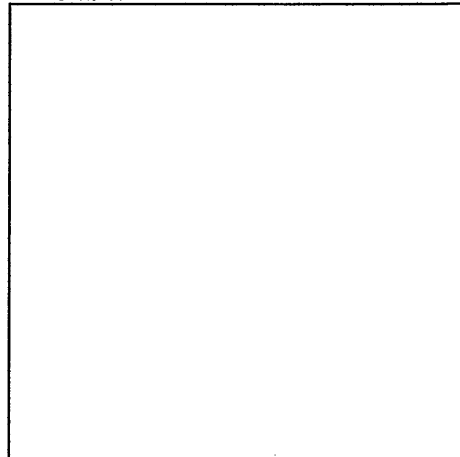
1. One metre distance, no barriers, listener facing towards child and researcher
2. One metre distance, no barriers, L facing away from C&R
3. One metre distance, no barriers, C&R facing away from L
4. One metre distance, barrier between C&R and L
5. Fifteen+ metre distance, no barriers, L facing towards C&R
6. Fifteen+ metre distance, no barriers, L facing away from C&R
7. Fifteen metre distance, no barriers, C & R facing away from L
8. Fifteen+ metre distance, barrier between C&R and L

Draw 2 simple diagrams, illustrating position of child, listener and barrier

1m. trials



15m. trials



Relationship of listener to child.....

Warm-up - Talk to the child about hearing/listening. Ask about quiet and loud sounds etc., to ascertain that the child understands what 'hearing' is.

Child, researcher and 'listener' in base room. Show the child the bell, and allow her/him to play with it for a couple of minutes. Show the false ears and let the child experiment with the ears. Tell the child that we want to find out when the listener can hear the bell. If he/she thinks that the bell can be heard by the listener, hold up the ears, if not, hide the ears behind her/his back.

Training trials:

Score first response, praise correct answers (Yes well done! No, think again, what do you do if N can hear/not hear?) Give corrective feedback on response errors. Ask:

T1. "What do you do if N can't hear it?"	show	hide
T2. "What do you do if N can hear it?"	show	hide
T3. "And again - What do you do if N can hear it?"	show	hide
T4. "Last try - What do you do if N can't hear it?"	show	hide

If the child understands the response format, continue. If not, explain again, and repeat the training trials. Researcher asks the listener to go to each location in turn (randomised presentation), says to the child:

"(Name) is in the (location, with additional information e.g. facing towards/away from us). (Researcher rings bell). Do you think that (name) can hear the bell?"

Trial 1. Number 1 - One-metre distance, no barriers, listener facing towards child and researcher

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

Trial 2. Number 2 - One-metre distance, no barriers, L facing away from C&R

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

Trial 3. Number 8 - Fifteen+ metre distance, barrier between C&R and L

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can

g) other

Trial 4. Number 7 - Fifteen metre distance, no barriers, C & R facing away from L

Hear not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

Trial 5. Number 6 - Fifteen+ metre distance, no barriers, L facing away from C&R

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

Trial 6. Number 5 - Fifteen+ metre distance, no barriers, L facing towards C&R

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

Trial 7. Number 4 - One-metre distance, barrier between C&R and L

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

Trial 8. Number 3 - One-metre distance, no barriers, C&R facing away from L

Hear Not hear DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't hear the bell?

- a) distance
- b) sound level
- c) sensory action
- d) vision related:
 - barrier
 - orientation
 - other
- e) irrelevant information
- f) don't know/no answer/just can
- g) other

General comments/observations:

Task 2

Predicting when vision is possible – the effects of distance, barriers and orientation

Materials/procedure:

A pair of false eyes from MPH doll
One other person (adult or sensible child), the 'viewer', who moves to different locations as instructed.
Locations as in Task 1

Warm-up - Talk to the child about seeing and ascertain that the child understands what 'seeing' is.
Child, researcher and 'viewer' in base room. Show the false eyes and allow him/her to explore then for a moment. Tell the child that we want to find out when the 'viewer' can see us. If he/she thinks that we can be seen by the listener, hold up the eyes, if not, hide the eyes.

Training trials:
Score first response, praise correct answers (Yes well done! No, think again, what do you do if N can see/not see?) Give corrective feedback on response errors.

Ask:

T1. "What do you do if N can't see us?"	show	hide
T2. "What do you do if N can see us?"	show	hide
T3. "And again - What do you do if N can see us?"	show	hide
T4. "Last try - What do you do if N can't see us?"	show	hide

If the child understands the response format, continue. If not, explain again, and repeat the training trials.

Researcher asks the viewer to go to each location in turn (randomised presentation). Say to the child:
"(Name) is in the (location, with additional information e.g. facing towards/away from us). Do you think that (name) can see us?"

Trial 1. Number 1 - One-metre distance, no barriers, listener facing towards child and researcher

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

Trial 4. Number 2 - One-metre distance, no barriers, L facing away from C&R

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

Trial 3. Number 8. - Fifteen+ metre distance, barrier between C&R and L

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

Trial 2. Number 7 - Fifteen metre distance, no barriers, C & R facing away from L

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

Trial 5. Number 6 - Fifteen+ metre distance, no barriers, L facing away from C&R

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

Trial 6. Number 5 - Fifteen+ metre distance, no barriers, V facing towards C&R

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

Trial 7. Number 4 - One-metre distance, barrier between C&R and L

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
 - b) barrier
 - c) orientation
 - d) sensory action
 - e) hearing related
 - f) irrelevant information
 - g) don't know/no answer/just can
 - h) other
-

Trial 8. Number 3 - One-metre distance, no barriers, C&R facing away from L

See not see DK other

Record any comments/difficulties

Depending on the response, ask: Why do you think that N can/can't see us?

- a) distance
- b) barrier
- c) orientation
- d) sensory action
- e) hearing related
- f) irrelevant information
- g) don't know/no answer/just can
- h) other

General comments/observations:

APPENDIX 5

QUESTIONNAIRE FOR STUDY 3 STAGE 2 – ADULT VERSION

(CHILD VERSION IN COMIC SANS MS, SIZE 12 FONT)

Things that are important for seeing

Below is a list of 28 items that people think affect whether objects can be seen or not or how clearly they can be seen. Choose the 9 things that you think are the most important for seeing and put a circle around each one. You don't need to put them in order of importance.

Please fill in the following information before you start:

Thank you for taking the time to do this task.

- | | |
|-------------------------------|---|
| 1. Tiredness | 15. Illness |
| 2. Colour | 16. Alcohol/drugs |
| 3. Preconceived expectations | 17. Movement of object |
| 4. Smells | 18. Magnifying glasses/
telescopes/microscopes |
| 5. Barriers | 19. Angle |
| 6. Size of object | 20. Eyes open |
| 7. Light | 21. Thinking about other things |
| 8. Height of viewer | 22. Healthiness of eyes |
| 9. Noise | 23. Age |
| 10. Using one eye only | 24. Distractions |
| 11. Curves (bends) | 25. Mood |
| 12. Weather | 26. Corners |
| 13. Facing towards the object | 27. Transparency |
| 14. Distance | 28. Movement of viewer |

APPENDIX 6

PROFORMA FOR STUDY 3 STAGE 2 - RANKING TASK

Ranking factors that affect vision

Child's Name:

Child's VS:

Child's ID:

School:

Date:

Location tested:

Child's DoB:

Factor	Rank	Score
Eyes open		
Light		
Health of eyes		
Distance		
Noise		
Corners		
Smells		
Barriers		
Size of object		

Comments:

APPENDIX 7

PROFORMA FOR STUDY 4 – TRUE OR FALSE TASK

True or false task

Child’s Name:

Child’s DoB:

Child’s ID:

School:

Date:

Location tested:

Training trials:

Score first response, praise correct responses. Give corrective feedback on response errors.

T1. ‘You are a boy/girl’	True	
T2. ‘Today, the weather is snowy’	False	
T3. ‘Ducks say ‘moo’’	False	
T4. ‘You are in Year ...’	True	

If the child understands the response format, continue. If not, explain again, and repeat the training trials.

Comments/problems:

Blind children's understanding of vision

Study 5: True or false?

All items to be repeated twice to allow adequate processing of information. Items to be presented randomly for each participant, 'True' statements in bold print.

		True	False	Score
1	Vision always has to be in a straight line.			
2	If someone stands at the top of the stairs, she can't see a person standing at the bottom.			
3	When someone stands at the bottom of the stairs, he can see a person standing at the top.			
4	If someone stands on a table, people on the floor can't see his head.			
5	Vision can't go round corners and bends.			
6	People standing at the back of the school hall can see a person standing on the stage, but not the colour of their clothes.			
7	People standing on the stage at school can see people at the back of the hall clearly enough to recognise their faces.			
8	Small things, like pins can only be seen if they're near enough to touch.			
9	If a person is running other people can see them clearly.			
10	Things and people can't be seen if they are very still.			
11	Seeing through a window is as clear as seeing when there's nothing at all in between.			
12	If someone crouches down behind the settee, a person crouched down at the other side can see them.			
13	People don't need to touch things in order to be able to see them clearly.			
14	Things look clearer when they are making a noise.			
15	People can see colours in a mirror.			
16	When it's windy, people can see further.			
Total score:				

APPENDIX 8

PROFORMA FOR STUDY 5 – HIDE-AND-SEEK TASK

Study 5: Hide-and-seek

Child’s Name: Child’s DoB:
Child’s ID: School:
Date:
Location tested: *Before bringing the child to the room, the following scenario should be set up:*

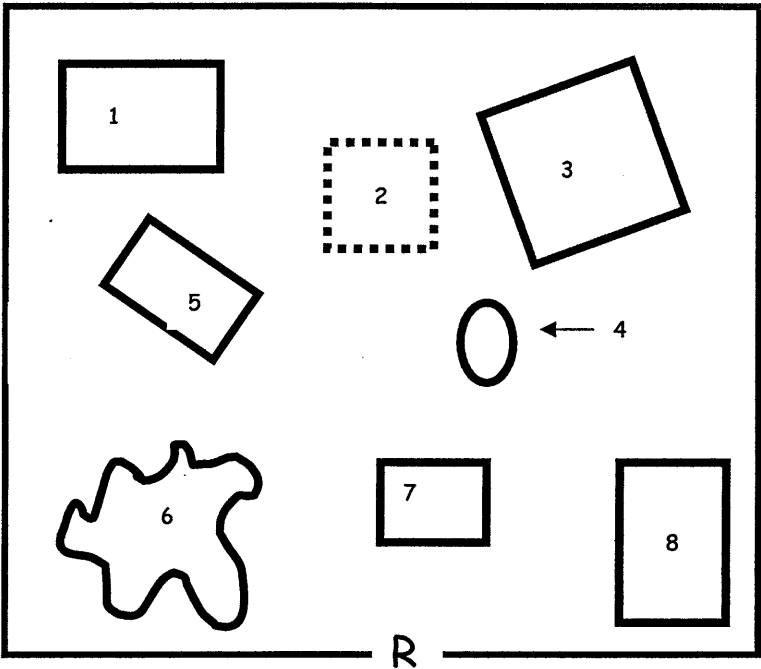


Figure 11.1: Layout for Hide-and-seek task (4½ m x 4½ m)

- Key:
- | | | |
|-------------------------|----------------------------------|---------------------------------|
| 1 = covered table | 4 = mask | 7 = small plastic storage crate |
| 2 = mesh fireguard | 5 = medium plastic storage crate | 8 = table |
| 3 = large cardboard box | 6 = sleeping bag | R = researcher’s position |

Scoring

Hiding place chosen

Fully hidden	Partially hidden	Not hidden at all
--------------	------------------	-------------------

Describe how the child is hidden, noting which parts of the body are hidden or visible as appropriate.

Record any comments or observations, or difficulties experienced by the child.

APPENDIX 9

PROFORMA FOR STUDY 6 – INTERVIEW PROMPT SHEET

The purpose of this interview is to obtain information about how children develop an understanding of the experience of vision.

Name:

Name of child:

Relationship to child:

Child's date of birth:

1. What do you think that C understands about what sighted people mean by 'seeing/vision'? Can you give some examples of things he/she has said or done that lead you to think this?
2. Does C understand that sighted people don't need to touch things in order to see them? Can you give some examples of things he/she has said or done that lead you to think this?
3. Does C ever use vision related language, e.g. talking about colour, light/dark/shadow etc. If so, what do you think this term means to C?
4. Does C ever hide from you or other people? If yes, describe situations, and describe how well hidden C was.
5. Does C ever hide objects from you? If yes, describe situations, and describe how well hidden C was.
6. Does C ever ask questions about vision and seeing? If yes, can you give some examples?
7. Do you think it's important for children who are blind to develop an understanding of vision and seeing? Why/why not?
8. Have you ever played games or conducted activities specifically to help C understand about vision and seeing?
9. Are there any naturally occurring events/situations that you think may have helped C to develop an understanding of vision and seeing?
10. Do you think that interactions with sighted peers and siblings affects C's understanding about vision and seeing? If yes, in what ways?
11. Have you ever talked with C about things that you think might have helped him/her to understand about vision and seeing?
12. Do you think C's experience of the other senses (touch, hearing, smell and taste) helps him/her to understand about vision and seeing? If yes, how?
13. Educators only: Is there anything in the National Curriculum that you think would help a blind child to develop an understanding about vision and seeing? Are there any ways in which this could be improved or developed?

APPENDIX 10
RAW DATA FOR BLIND CHILDREN ON ASPECTUALITY TASKS

Child ID	Age	Group	FindOut touch	FindOut hear	FindOut see	FindOut smell	FindOut taste	FindOut Total	MPH touch	MPH hear	MPH see	MPH smell	MPH taste	MPH Total	Total score
B	3:6	Younger	2	2	0	0	0	4	0	0	0	0	0	0	4
G	5:10	Younger	2	2	0	3	1	8	1	1	1	1	1	5	13
M	7:1	Younger	3	3	2	3	0	11	1	1	1	1	0	4	15
D	7:6	Younger	3	3	2	3	0	11	1	1	1	1	0	4	15
O	7:6	Older	3	3	2	3	3	14	1	1	1	1	1	5	19
C	7:8	Older	3	3	2	3	3	14	1	1	1	1	1	5	19
As	8:11	Older	3	3	2	3	3	14	1	1	1	1	1	5	19
Mo	9:5	Older	3	3	2	3	3	14	1	1	1	1	1	5	19

APPENDIX 11

RAW DATA FOR BLIND CHILDREN ON UNDERSTANDING HEARING AND UNDERSTANDING VISION TASKS

Child ID	Age	*H1	H2	H3	H4	H5	H6	H7	H8	Total U.Hearing	**S1	S2	S3	S4	S5	S6	S7	S8	Total U.Seeing
B	3;6	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	4	1.0	0.0	1.0	3.0	.0	1.0	0.0	0.0	6
G	5;10	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	24	3.0	0.5	3.0	0.5	0.5	0.0	3.0	0.0	10.5
M	7;1	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	4	0.0	0.5	0.5	3.0	1.0	0.5	0.0	3.0	8.5
D	7;6	3.0	0.0	3.0	3.0	0.0	3.0	0.0	3.0	15	3.0	3.0	3.0	0.0	3.0	3.0	3.0	3.0	21
O	7;6	3.0	3.0	3.0	0.5	3.0	3.0	3.0	3.0	21.5	3.0	3.0	3.0	3.0	0.5	3.0	0.5	0.5	16.5
C	7;8	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	24	3.0	3.0	3.0	0.0	3.0	3.0	3.0	3.0	21
As	8;11	3.0	3.0	3.0	3.0	0.0	0.0	0.0	3.0	15	3.0	3.0	3.0	0.0	3.0	3.0	3.0	3.0	21
Mo	9;5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	24	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	24

*H= Understanding Hearing

**S=Understanding Seeing

Trial	Code
H/S1	near/facing
H/S2	near/L/V away
H/S3	near/C&R away
H/S4	near/barrier/facing
H/S5	far/facing
H/S6	far/L/V away
H/S7	far/C&R away
H/S8	far/barrier/facing